United States Department of Commerce
National Marine Fisheries Service

United States Department of the Interior
Fish and Wildlife Service

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510 Desmond Drive S.E., Suite 103
Lacey, Washington 98503

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May 4, 2004

Kevin Rochlin
U.S. Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Dear Mr. Rochlin:

Subject: Biological Opinion and Essential Fish Habitat Consultation for the Duwamish/Diagonal Sediment Remediation Project, Duwamish Waterway, Seattle, Washington (NOAA Fisheries No. 2003/01335; U.S. Fish and Wildlife Service No. 1-3-04-F-0090) (Duwamish HUC 17110013).

In accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*) and the Magnuson Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996, the attached documents transmit NOAA's National Marine Fisheries Service (NOAA Fisheries) and U.S. Fish and Wildlife Service's (FWS) Biological Opinion (Opinion) and NOAA Fisheries MSA consultation on the issuance of a permit for contaminated sediment removal and capping in the Duwamish Waterway, Seattle, Washington. The Environmental Protection Agency (EPA) determined that the proposed action may affect, and is likely to adversely affect the Puget Sound (PS) chinook (*Oncorhynchus tshawytscha*) Evolutionarily Significant Unit and the Distinct Population Segment of the Coastal-Puget Sound bull trout (*Salvelinus confluentus*). NOAA Fisheries and the FWS concurred with the likely to adversely affect determination but concluded that implementation of the proposed project is not likely to jeopardize the continued existence of PS chinook or PS-Coastal bull trout.

This Opinion reflects the results of a formal ESA consultation and contains an analysis of effects covering the PS chinook and PS-Coastal bull trout in the Duwamish Waterway, Washington. The Opinion is based on information provided in the Biological Evaluation sent to NOAA Fisheries and the FWS by the EPA, and additional information transmitted via meetings, telephone conversations, and e-mail. A complete administrative record of this consultation is on file at the NOAA Fisheries Washington Habitat Office and the U.S. Fish and Wildlife's Western Washington Office.

In order to consult efficiently on anadromous fish with similar biological requirements, this consultation was prepared jointly. Separate analyses of jeopardy were prepared by NOAA Fisheries for PS chinook and by the FWS for bull trout. Also included is a separate MSA consultation which concluded that the proposed project may adversely impact designated Essential Fish Habitat. Because the conservation measures that the EPA included as part of the proposed action are adequate to avoid, minimize, or otherwise offset potential adverse impacts to the Essential Fish Habitat additional conservation recommendations pursuant to MSA are not necessary.

Key features to be included as conditions of the action include the following commitments by EPA that will serve to reduce the adverse effects to bull trout and chinook salmon. The Service's analysis of incidental take and jeopardy are based on the implementation of these measures:

a) EPA will require work to be conducted within the work window of July 15 through March 1 when PS chinook salmon and bull trout are least likely to be present.

b) EPA will require compliance of water quality standards by conducting water quality measurements during clean up activities for turbidity, total suspended solids and contaminants of concern at the dredge and capping site. Appropriate monitoring will include turbidity, total suspended solids, and chemicals of concern for the first week at two tidal cycles and at two depths, and additional sampling if standards are exceeded. Samples will be taken at the edge of the mixing zone (as specified in the Clean Water Act (CWA) section 401 certification) and at the halfway point within the mixing zone. Water quality sampling will include up- or down-stream reference samples (depending on the tide) to allow for turbidity due to dredging, transport, or disposal operations to be separated from background turbidity. If turbidity standards under the CWA are not met at the mixing zone, the dredging/dewatering operations will cease until minimization measures are incorporated so that turbidity standards can be met.

c) EPA will supply the contractor with more detailed information so that the dredging will be carried out in a manner that minimizes spillage of excess sediments from the bucket and minimizes the potential entrainment of fish. This includes, but is not limited to:

i) Using effective materials such as hay bales or filter fabric on the barge to avoid contaminated sediment and water from being deposited back into the river.

ii) Avoiding the practice of washing contaminated material off the barge and back into the water. This can be accomplished by the use of hay bales and/or filter fabric.

iii) Using filter fabric or some other device to minimize spillage of material into the water during the unloading of the barge to the upland facility.

iv) Using effective materials such as hay bales or eco-blocks and filter fabric to minimize contaminated sediments and water from being deposited back into the water during transportation between the barge and the upland facility.

d) EPA will provide the contractor specific directions regarding the most current, accurate Global Positioning System dredge-positioning to control the horizontal and vertical extent of the dredge. A horizontal and vertical control plan will be prepared, submitted to the contractor, and adhered to by the dredge contractor to ensure dredging does not occur outside the limits of the dredge prism.

e) EPA will ensure that an emergency clean-up plan is in place in the event the barge, truck, or railcar has an incident where the contaminated material is spilled. This plan will be on-board all of the transportation vehicles at all times.

f) EPA will use clean sand with minimal fine sediments during the capping operation.

g) EPA will analyze capping material if it is from another dredge location than described in the Biological Assessment. Puget Sound Dredge Disposal Analysis will be performed on that sediment prior to its use, and it must meet Puget Sound Dredge Disposal Analysis standards.

h) EPA will monitor the chemical constituents, turbidity, dissolved oxygen and other in-water parameters, and will modify the dredging practices by conventional means (*e.g.*, rate of dredging, changing bucket type, scheduling on tidal cycles), if any of the parameters exceed Clean Water Act water quality criteria.

It is important to note that if there is any deviation from the original project description, EPA shall contact the Services to determine if the change is significant enough to modify the incidental take statement. This can be conducted by phone or e-mail.

If you have any questions, please contact Shandra O'Haleck of the Washington State Habitat Office at (360) 753-9533 or at shandra.o'haleck@noaa.gov or Brian Missildine of the Western Washington Fish and Wildlife Service Office at (360) 753-9561 or at brian_missildine@fws.gov.

Sincerely,

Michael R Crouse

D. Robert Lohn
Regional Administrator
NOAA Fisheries

Ken S. Berg

Ken S. Berg, Manager
Western Washington Fish and Wildlife Office

Endangered Species Act - Section 7 Consultation
Biological Opinion

National Marine Fisheries No. 2003/01335
and
U.S. Fish and Wildlife No. 1-3-04-F-0090

East Waterway
Phase 1 Non-Time Critical Removal Action, Harbor Island Superfund Site
Duwamish Waterway, Seattle, Washington

Agency: United States Environmental Protection Agency

Consultation Conducted By: National Marine Fisheries Service
Northwest Region
and
U.S. Fish and Wildlife Service
Western Washington Fish and Wildlife Office

Issued by: Michael R Crouse Date: May 4, 2004
D. Robert Lohn
Regional Administrator

Ken S Berg Date: May 4, 2004
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1.0 INTRODUCTION

1.1 Background and Consultation History

On October 23, 2003 NOAA's National Marine Fisheries Service (NOAA Fisheries) and the United States Fish and Wildlife Service (FWS) received a Biological Evaluation (BE) and a request for Endangered Species Act (ESA) Section 7 consultation from the United States Environmental Protection Agency (EPA). The proposed action to review under this Biological Opinion (Opinion) would allow work to occur under EPA's oversight, pursuant to an Administrative Order under Superfund authority signed by EPA and the Port of Seattle (Port). The EPA's removal order, contained in a Consent Decree to the Port, is considered a Federal action under the ESA. The EPA concluded that, while it may be difficult to quantify effects on listed species from this action, the conservative position must be taken that the proposed dredging and capping activities are likely to adversely affect (LAA) Puget Sound (PS) chinook salmon (*Oncorhynchus tshawytscha*) and the Coastal-Puget Sound Distinct Population Segment (DPS) of bull trout (*Salvelinus confluentus*) in the short term. NOAA Fisheries and FWS (together, the Services) concurred with the EPA effect determination and initiated formal consultation on October 31, 2003, and December 10, 2003, respectively. A complete administrative record of this consultation is on file at both the FWS and NOAA Fisheries office in Lacey, Washington.

The Port is proposing in-water dredging activities in the East Waterway of the Duwamish (Figure 1) with the concurrent objectives of sediment cleanup and navigational improvements. The Port has agreed to remove sediments contaminated with polychlorinated biphenyls (PCBs), pesticides, bis (2-ethylhexyl) phthalate, polyaromatic hydrocarbons (PAHs), phenols, chlorobenzenes, and metals including mercury, zinc, and tributyltin from the lower Duwamish River estuary near Seattle, Washington (Duwamish HUC 17110013). Approximately 200,000 cubic yards of contaminated material and 60,000 cubic yards of clean material would be excavated from 19.5 acres of subtidal habitat with final dredge elevation at minus 51 feet below Mean Lower Low Water (MLLW). Disposal of the contaminated sediments from this project will be at an approved upland facility while the clean material will be disposed of at the Puget Sound Dredge Disposal Analysis (PSDDA) site in Elliott Bay. The proposed project occurs within the PS chinook Evolutionary Significant Unit (ESU) and the Coastal-Puget Sound bull trout DPS.

In the long term, removal and isolation of the contaminated sediments will benefit the species that utilize the lower Duwamish River. However, short-term adverse effects on fish associated with the project activities are possible, including adverse effects resulting from increased turbidity, water quality effects, contaminant exposure, and potential fish entrainment during dredging activities. These effects are expected to be temporary and would be minimized by project conservation measures and best management practices. NOAA Fisheries and the FWS concur with the EPA effect determination of likely to adversely affect.

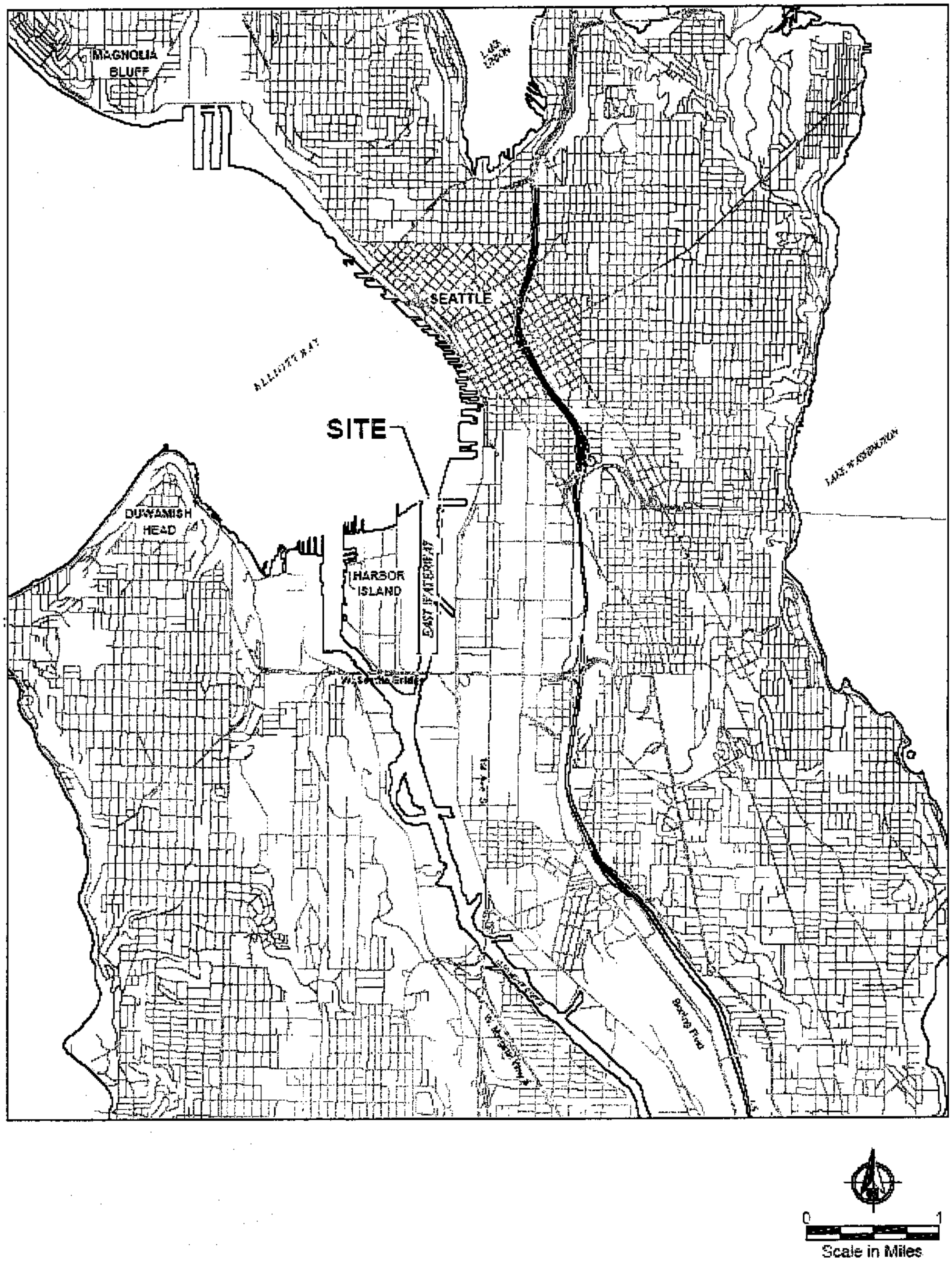

Figure 1. Location of the East Waterway (Map courtesy of Port of Seattle/Anchor Environmental).

The objective of this Opinion is to determine whether the proposed action is likely to jeopardize the continued existence of PS chinook salmon and/or Coastal-Puget Sound bull trout, both listed as threatened under the ESA. The standards for determining jeopardy are described in Section 7(a)(2) of the ESA and further defined in 50 CFR 402.14. This Opinion is based on information provided in the BE and correspondence with the applicant. The term "salmonids" refers to both PS chinook salmon and Coastal-Puget Sound bull trout.

1.2 Description of the Proposed Action

The EPA proposes to issue an approval to the Port, under Superfund authority, for the dredging of contaminated sediments, stockpiling and stabilizing the sediment, and for the transportation and disposal of 200,000 cubic yards of contaminated material at an approved upland facility. Approximately 60,000 cubic yards of material has been determined to be suitable for open-water disposal and will be disposed of at the Elliott Bay PSDDA site.

1.2.1 Dredging

Proposed dredging for the combined purpose of sediment cleanup and navigational improvements includes excavation of approximately 260,000 cubic yards of existing subtidal sediments from approximately 19.5 acres of the East Waterway of the Lower Duwamish. The EPA has instructed the Port to address sediment contamination in the East Waterway Operable Unit (EWWOU) of the Harbor Island Superfund site per the process defined by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or Superfund. All dredging would occur in subtidal areas with depths greater than minus 10 MLLW (until final bottom elevation equals minus 51 feet MLLW).

A mechanical clamshell dredge equipped with a digital global positioning system (GPS), triangulation, or range-range/range-azimuth electronic positioning system will be used. Operational procedures to minimize environmental impacts during dredging include: increased cycling time, eliminating multiple bites, eliminating dredging during peak tidal exchange periods, eliminating bottom stock piling, eliminating barge overflow and leakage, having filter material on barge scuppers, and, limiting resuspension during capping. Because of these procedures, it is anticipated that only 1,500 to 2,500 cubic yards of material will be dredged per day. Assuming a six-day work week and based on an estimated 2,000 cubic yard per day production, it is estimated that removal will take 3 to 5 months to complete. It is anticipated that barges ranging from 1,000 to 3,000 cubic yards will be used. Based on the production rate of 1,500 to 2,500 cubic yards of material to be dredged per day, it is likely that barge traffic in this area will increase by one to two barges per day.

Since the entire dredge area cannot be completed in one season, the EPA had designated three regions within the dredge prism for priority sediment removal. The region designation spatially divides the area to be dredged into two western (W and W-prime) and one eastern (E) region with the western regions having priority for dredge sequencing (Figure 2).

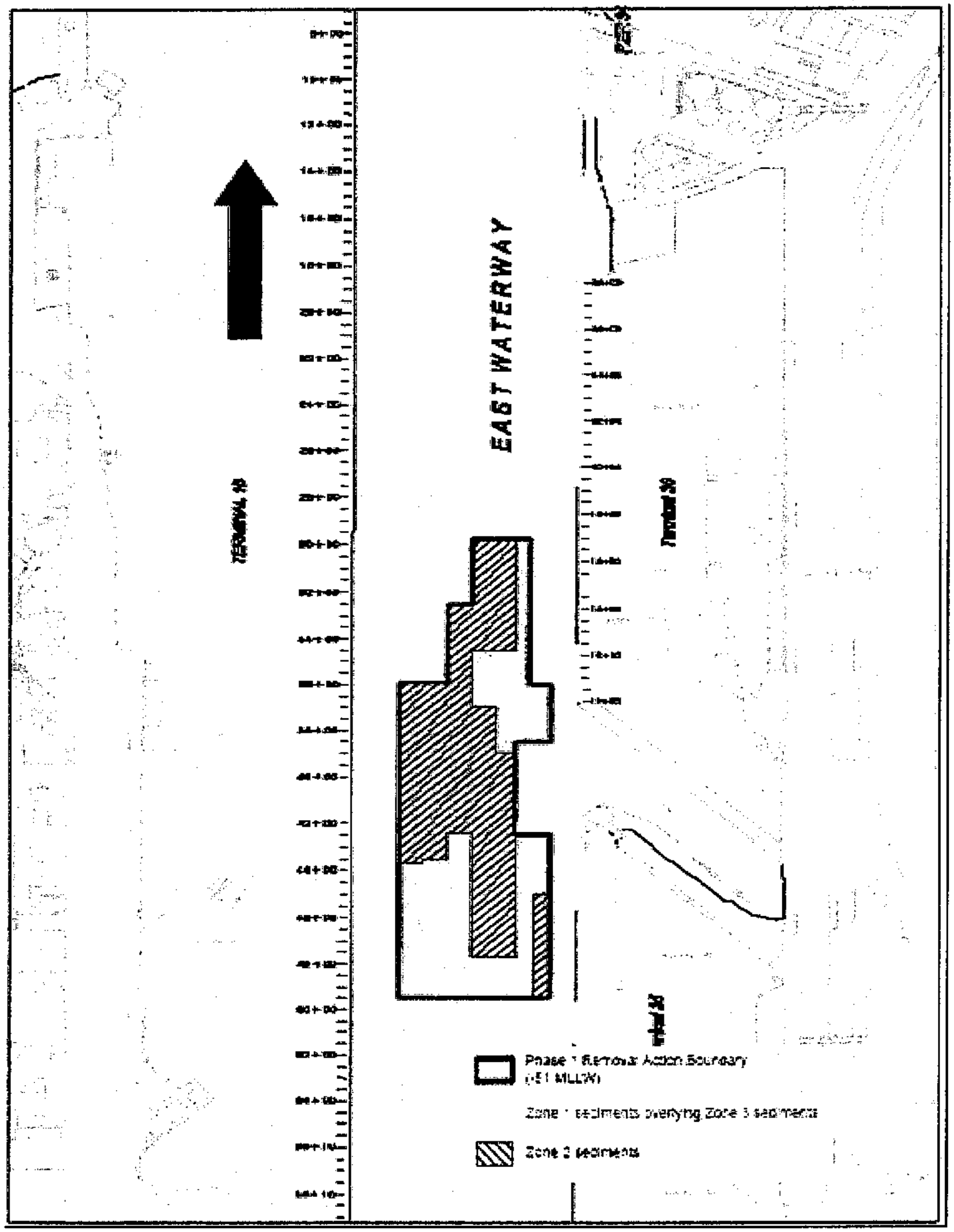

Figure 2. Priority dredge removal prisms (Map courtesy of Port of Seattle/Anchor Environmental)

1.2.2 Transport of Dredged Materials

Sediment transferred to the barge will need to be dewatered. Filter media, to cover the runoff ports of the barge, or a filtered sanitary sewer connection to the upland will be used if passive dewatering from the barge occurs. If it is more economical for the production rate, active dewatering will be performed which includes mechanical dewatering systems using filters, presses, centrifuges, and/or hydrocyclones. Alternately, or in conjunction with mechanical measures, stabilization measures such as lime, fly ash, cement, or other additives would be added to the sediment to enhance dewatering. Liquid discharges from the barge during dredging will be required to meet EPA Water Quality Criteria (Section 401 of the Clean Water Act).

Contaminated sediments that are being disposed of in an upland landfill site will be transferred from the barges to a handling area adjacent to the East Waterway, which may include Terminal 25, Terminal 30, and/or Terminal 18. It is expected that the contractor will offload the barge into the dewatering or processing area using a land-based crane and rehandling bucket or long-stick hydraulic excavator.

Any effluent generated by material that is stock piled and dewatered upland will be sampled, treated (if necessary), and required to meet applicable water quality standards prior to discharge back into the East Waterway. Upland dewatering and stockpile effluent that is discharged to the publicly owned treatment facility is required to meet criteria of the publicly owned treatment facility. Debris and contaminated sediments would be transported by rail or truck to an approved upland facility that is authorized to accept such material. Typical practice is to load the material into open-top, lined containers and to cover the containers prior to loading them onto the truck or railcar.

Sediment determined to be suitable for open water disposal will be dredged and loaded on a bottom dump barge. Once the U.S. Coast Guard verifies that the barge is at the target location, the barge will open and discharge the sediment.

1.2.3 Capping

Capping will occur should surface sediments show that chemical results exceed Cleanup Screening Levels (CSL). Representative sample areas will be dredged an additional 1 to 2 feet and a thin clean sediment cap (minimum 6 inches) will be applied. Cap material will be clean, free-draining sand graded per limits specified in the Removal Action Design Report (Anchor Environmental 2003). The required cap elevation (minimum area within the contingency dredge where the sediment cap is required to be placed) is minus 53 feet MLLW.

Placement of the cap material will be conducted by a dredge rehandling bucket, tremie tube, hydraulic washing, and/or a split-hull barge. The rehandling bucket would grab cap material from the haul barge and lower the material through the water column before opening slightly above the mudline; the tremie tube would extend through the water column to deposit the material slightly above mudline; hydraulic spraying would consist of spraying the material off the deck of the barge; and the use of the split-hull barge would consist of slowly cracking open the barge while moving slowly over the area to be capped. In each case, the construction method would minimize the disturbance of *in situ* sediments due to the process of low-energy placement.

1.2.4 Monitoring

The purpose of the monitoring is to provide ongoing assessment of water quality during dredging activities and to determine whether the exposed sediment surface after dredging complies with cleanup standards. The Port will arrange for a third party to monitor water quality during dredging. Monitoring will consist of hydroacoustic surveys, *in situ* water quality measurements, and collection and analysis of water grab samples. Additional observations will be made by the field crew and will note the following:

1. Evidence of significant oil sheen.
2. Observations of distressed or dying fish.
3. Floating and suspended materials generated by the construction activities, recorded by visual observations.
4. Discoloration and turbidity; record description of color, source, and size of affected area.

Work will immediately stop if there is (1) evidence of a significant oil sheen, (2) dying fish, or (3) if the dissolved oxygen (DO) falls below 3.5 mg/L at any location. The Water Quality Monitoring plan (WQM-Anchor Environmental 2003) provides complete details for conducting the water quality monitoring program.

The sediment quality of the exposed surface after dredging will be evaluated by collection and analysis of surface grab samples during a post-dredge sediment quality survey. If cleanup standards are not met, contingency actions will include additional dredging (1 foot) and the application of a thin-layer (6-12 inch) clean sediment cap. Post-dredge testing and resultant actions are discussed in the East Waterway Phase 1 Post-dredge Monitoring Program and Quality Assurance Project Plan which includes the following measures:

1. If all chemical results are below State Quality Standards (SQS) then work will be complete.
2. If a bioaccumulative target chemical result exceeds SQS, the Port will consult with the EPA and the Services regarding corrective actions in the area of exceedance.
3. If any other chemical results exceed SQS but are below CSL, the Port will consult with EPA and the Services regarding required corrective actions in the area of exceedance.
4. If any of the other chemical results exceeds CSL then representative sample areas will be dredged an additional 1 foot, and a thin clean layer cap will be applied.

Accurate measurements of the dredging depths and potential capping elevations would be monitored to document that the construction of the dredge and potential cap adheres to the specifications in the dredging and capping plan. Detailed bottom surveys would be conducted at a minimum of three times to monitor construction activities (before dredging, after dredging, and after capping), but additional surveys may be required if the contractor is directed to correct some part of the construction work.

The monitoring vessel for detailed bottom surveys and any potential water sampling would be equipped with a navigation system with a minimum accuracy of plus or minus 3 feet. The system would be capable of logging way-points so that the position of the construction operation can be recorded and the distance to potential water sampling stations can be determined.

1.2.5 Duration and Timing

The project schedule calls for in-water construction work to begin in January 2004 and occur over roughly two construction seasons, with dredging operations completed before March 1, 2005. Dredging operations will occur only between July 15th and March 1st of any year. All exposed sediment will be tested as clean or will be capped with clean sediment between seasons.

1.3 Description of the Action Area

An action area is defined by ESA regulations (50 CFR Part 402) as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved by the action." The action area for the proposed project is considered to be that portion of the lower Duwamish River beginning at the upstream limit of the winter salt wedge at approximately River Mile (RM) 9 extending downstream to include inner Elliott Bay.

2.0 ENDANGERED SPECIES ACT

2.1 Biological Opinion

The purpose of consultation under the ESA is to ensure that any action authorized, funded or carried out by a Federal agency is not likely to jeopardize the continued existence of threatened or endangered species. Formal consultation concludes with the issuance of a Biological Opinion under section 7(b)(3) of the ESA.

2.1.1 Status of the Species, Puget Sound Chinook

The ESU for PS chinook salmon was listed as threatened under the ESA on March 24, 1999 (64 Fed. Reg. 14308). The ESU includes all naturally spawned populations of PS chinook salmon from rivers and streams flowing into the Puget Sound. This area also includes the Straits of Juan de Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound, and the Strait of Georgia in Washington State. The species status review identified the high level of hatchery production which masks severe population depression in the ESU, as well as severe degradation of spawning and rearing habitats, and restriction or elimination of migratory access as causes for the range-wide decline in PS chinook salmon stocks (NOAA Fisheries 1998a, and 1998b). Critical habitat designation is not in effect for PS chinook salmon.

Overall abundance of PS chinook salmon in this ESU has declined substantially from historical levels. Many populations are small enough that genetic and demographic risks are likely to be relatively high. Long-term trends in abundance are predominantly downward, with several populations exhibiting short-term declines. Factors generally contributing to the downward trend are widespread stream blockages, degraded habitat, with upper tributaries widely affected by poor forestry practices and lower tributaries and mainstream rivers affected by urbanization and agriculture. Hatchery production and releases of PS chinook salmon in Puget Sound are widespread and more than half of the recent total Puget Sound escapement returned to hatcheries.

2.1.1.1 Factors Affecting Species in the Action Area

The action area is a highly industrialized, salt wedge estuary influenced by river flow and tidal cycles. The urbanization and industrialization of this portion of the Green River watershed has resulted in an extensive system of filled tidelands and flood control revetments that have eliminated connectivity to the historic floodplain and decreased or eliminated stream channel complexity, functional riparian zones, and floodplain habitats.

The Duwamish Waterway shoreline between the mouth and River Mile (RM) 6.5 is 44 percent riprapped, 34 percent covered by pier aprons, and 7 percent faced with vertical sheet piling (Tanner 1991). Dredging for navigational purposes coupled with industrial activities has resulted in adverse changes in the substrate characteristics and the amount of shallow water habitat available for fishery resources utilizing this estuary (Meyer *et al.* 1981). Furthermore, a considerable portion of the remaining intertidal and shallow subtidal portions of the Lower Duwamish Waterway are covered by barges (Muckleshoot Indian Tribe Fisheries Department [MITFD], unpub. data). The historical distributions of juvenile anadromous salmonids into off-channel distributary channels and sloughs have largely been eliminated and historical saltwater transition zones are lacking (Kerwin 1999). Additionally, the chemical contamination of sediments from stormwater and wastewater effluents in certain areas of the Waterway has compromised the effectiveness of the small amount of habitat surviving (COE 2002).

2.1.1.2 Status of the Species Within the Action Area

Chinook salmon migrating through the Duwamish River estuary are Green/Duwamish River summer/fall stock (NOAA 2003). Spring chinook were historically present in the Green/Duwamish River basin. However, returns are in such low numbers that they are difficult to detect. It is possible that the spring run became extirpated by the original construction effects of the Tacoma Headworks Dam in 1911, or became isolated from the basin by the diversion of the White River in 1906 (Kerwin and Nelson 2000).

Green/Duwamish summer/fall chinook salmon remain relatively abundant because of hatchery production. According to the draft NOAA Fisheries Biological Review Team (BRT) Assessment (2003), the overall trend in abundance of Green River chinook salmon is predominantly downward. Green River chinook are noted for a high degree of hatchery influence (approx. 70%). Fishing pressure on the population was judged 57% by the BRT for the last 5 years. Overall annual numbers of Green River chinook were estimated at about 550 by the BRT for the recent 5 years.

Summer/fall chinook salmon in the Green/Duwamish system are ocean-type fish that rear in freshwater for a few months after emerging from the gravel before migrating to the ocean in the spring as sub-yearling smolts. Juveniles are abundant in the mainstem of the Green River from March through April and occur in the Lower Duwamish Waterway from early March through late July (Meyer *et al.* 1981; Low and Myers 2002). Other studies have found juvenile chinook salmon in the Duwamish as early as mid February (K. Fresh pers. comm. 2003). Screw trap data that began to be collected at River Mile (RM 34.5) of the mainstem of the Green River on February 10th of 2002, indicated that migration of juvenile chinook salmon was already well under way by that date(Seiler *et al.* 2002). Nelson (pers. comm. 2003) marked juvenile chinook salmon from RM 34.5 of the Green River and found that the tagged fish had reached RM 5.5, the turning basin for the lower Duwamish industrial area, within 4 days. The chinook were found to hold within the turning basin until the April/May time period when migration to the salt water began (Nelson pers. comm. 2003; Taylor pers. comm. 2003). Although juvenile chinook are present in the Lower Duwamish Waterway over an 8-month period, catch data show an abrupt increase in smolts in mid-May followed by an equally abrupt decrease. This indicates that most of the fish represented in the pulse of abundance were not in the Lower Duwamish Waterway for more than 2 weeks (Warner and Fritz 1995).

Seiler (1999) found that chinook salmon preferred nighttime migration in the Cedar and Bear Rivers. For the first 4 weeks of trap operation, beginning January 23rd, weekly day/night ratios for chinook varied from 17 percent to 59 percent and declined as the season progressed. A comparison of the passage timing data with lunar data for Lake Washington and the Hiram M. Chittenden Locks suggested a strong correlation between moon location relative to the earth and emigration timing, particularly in the case of chinook and coho salmon. This correlation appeared to be stronger than the correlation between emigration and moon phase (illumination). Migration through the Chittenden Locks increased markedly within a day or two of the moon being at apogee (i.e., when the moon is farthest from the earth). Emigration decreased by the time of the next apogee (R2 Resource Consultants 2002). Juvenile chinook salmon in the Green/Duwamish River would be expected to exhibit similar timing to Cedar River chinook salmon, since the two rivers were connected until about 1917.

Similar to timing of juvenile chinook emigration peaks in the Duwamish estuary, increasing abundances of juvenile chinook salmon have been observed in Elliott Bay, but only through the summer months. Taylor *et al.* (1999) found the greatest numbers of juvenile chinook salmon at Terminal 5, located immediately west of Harbor Island, in mid-May, and at Pier 91, located 4 miles north of the Duwamish, in early June. Beamish *et al.* (1998) sampled salmonids throughout Puget Sound and observed that some juvenile chinook salmon remain in Puget Sound through fall and winter (Starkes 2001).

Generally, chinook salmon remain at sea for 2 to 4 years before returning to freshwater to spawn. The summer/fall stock migrate upstream through the Lower Duwamish Waterway to spawning grounds from late June into early November, with large numbers entering the river by July

(Williams *et al.* 1975; Frissell *et al.* 2000; Kerwin and Nelson 2000). Adults primarily spawn between mid-September and October (WDFW 1994; Williams *et al.* 1975). No chinook salmon spawning is known to occur in the Lower Duwamish Waterway or in the smaller streams flowing into the estuary and lower reaches of the waterway (Weitkamp *et al.* 2000).

2.1.2 Status of the Species, Coastal-Puget Sound DPS of Bull Trout

On November 1, 1999, the Service (USDI 1999) listed five DPSs of the bull trout within the coterminous United States as threatened. These 5 DPSs, with 187 subpopulations, include: 1) the Coastal-Puget Sound DPS, with 34 subpopulations; 2) the Columbia River DPS, with 141 subpopulations; 3) the Jarbidge River DPS, with 1 subpopulation; 4) the St. Mary-Belly River DPS, with 4 subpopulations; and 5) the Klamath River DPS, with 7 subpopulations. Factors contributing to the decline of bull trout populations were identified in the listing rule and include restriction of migratory routes by dams and other unnatural barriers; forest management, grazing, and agricultural practices; road construction; mining; introduction of non-native species; and residential development resulting in adverse habitat modification, overharvest, and poaching (Bond 1992; Thomas 1992; Rieman and McIntyre 1993; Donald and Alger 1993; WDFW 1997). Critical habitat has been proposed only for the Columbia River and Klamath River DPSs.

In recognition of the scientific basis for the identification of bull trout DPSs (i.e., each DPS is unique and significant), the final listing rule specifies that these DPSs will serve as interim recovery units for the purposes of consultation and recovery planning until an approved recovery plan is completed. On that basis, the geographic scope of jeopardy analyses for actions under formal consultation will be at the DPS level as opposed to the entire coterminous United States range of bull trout. This Opinion will evaluate the effect of the proposed action on the Coastal-Puget Sound DPS of bull trout. The Green River/Duwamish River subpopulation(s) will be specifically addressed in this Opinion.

The Service developed a draft recovery plan for the Columbia River (USFWS 2002) and is currently developing the recovery plan for the Coastal-Puget Sound DPS. The bull trout recovery planning efforts are converting bull trout subpopulations into "core areas" (USFWS 2002). A core area is defined as the combination of core habitat (i.e., habitat that could supply all elements for the long-term security of bull trout) and a core population (a group of one or more local bull trout populations that exist within core habitat), which constitutes the basic unit on which to gauge recovery. Core areas require both habitat and bull trout to function, and represents the closest approximation of a biologically functioning unit for bull trout.

In general, core areas meet a set of criteria proposed by Rieman and McIntrye (1993) (see Lohr *et al.* 2001) and have been expanded by the bull trout recovery planning team to focus on restoration of conditions and activities that may be necessary for recovery. The 141 subpopulations within the Columbia River DPS are being converted into 88 core areas. The 34 Coastal-Puget Sound DPS subpopulations are being converted into 14 core areas.

2.1.3 Life History

Bull trout are a member of the char family and closely resemble another member of the char family, Dolly Varden (*Salvelinus malma*). Genetics indicate, however, that bull trout are more closely related to an Asian char (*Salvelinus leucomaenis*) than to Dolly Varden (Pleyte, *et al.* 1992). Bull trout are sympatric with Dolly Varden over part of their range, most notably in British Columbia and the Coastal-Puget Sound region of Washington State.

Bull trout distribution has been reduced by an estimated 55 percent in the Klamath River DPS and 79 percent in the Columbia River DPS since pre-settlement times, due primarily to local extirpations, habitat degradation, and isolating factors (Quigley and Arbelride 1997). Within the Coastal-Puget Sound DPS, bull trout distribution is similar to historic distributions, but population abundance has significantly decreased in some portions of this range (USDI 1999). Bull trout historically occurred in major river drainages in the Pacific Northwest, extending from northern California to the headwaters of the Yukon River in the Northwestern Territories of Canada (Cavender 1978; Bond 1992). In California, bull trout were historically found only in the McCloud River, which represented the southernmost extension of the species' ranges. The last confirmed report of this species in the McCloud River was in 1975, and the original population is now considered to be extirpated (Rode 1990). The remaining distribution of bull trout is highly fragmented.

Bull trout currently occur in rivers and tributaries in Montana, Idaho, Washington, Oregon (including the Klamath River basin), Nevada, two Canadian Provinces (British Columbia and Alberta), and several cross-boundary drainages in extreme southeast Alaska. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta, and the McKenzie River system in Alberta and British Columbia (Cavender 1978; McPhail and Baxter 1996; Brewin and Brewin 1997).

Bull trout populations exhibit four distinct life history types: resident, fluvial, adfluvial, and anadromous. Fluvial, adfluvial, and resident forms exist throughout the range of the bull trout (Rieman and McIntyre 1993) and spend their entire life in freshwater. The only known anadromous life history form within the coterminous United States occurs in the Coastal-Puget Sound region (Volk 2000; Kraemer 1994; Mongillo 1993). Highly migratory populations have been eliminated from many of the largest, most productive river systems across their range. Many "resident" bull trout presently exist as isolated remnant populations in the headwaters of rivers that once supported larger, more fecund migratory forms. These remnant populations lacking connectivity to migratory populations have a low likelihood of persistence (Rieman and McIntyre 1993; Rieman and Allendorf 2001).

The majority of the growth and maturation of anadromous bull trout occurs in estuarine and marine waters; for adfluvial bull trout, the major growth and maturation occurs in lakes or reservoirs; and for fluvial bull trout, the major growth and maturation occurs in large river systems. Resident bull trout populations are generally found in small headwater streams where the fish tend to spend their entire lives. These diverse life history types are important to the stability and viability of bull trout populations (Rieman and McIntyre 1993).

For all life history types, the juveniles tend to rear in tributary streams for 1 to 3 years before migrating downstream into a larger river, lake, or estuary and/or nearshore marine area to mature (Rieman and McIntyre 1993). In some lake systems, age 0+ fish may migrate directly to lakes (Riehle *et al.* 1997). Juvenile and adult bull trout frequently inhabit side channels, stream margins and pools with suitable cover (Sexauer and James 1993) and areas with cold hyporheic zones or groundwater upwellings (Baxter and Hauer 2000).

Bull trout become sexually mature between 4 and 9 years of age, and may spawn in consecutive or alternate years (Shepard *et al.* 1984; Pratt 1992). Spawning typically occurs from August through December in cold, low-gradient 1st to 5th-order tributary streams, over loosely compacted gravel and cobble having groundwater inflow (Shepard *et al.* 1984; Brown 1992; Rieman and McIntyre 1996; Swanberg 1997; MBTSG 1998; Baxter and Hauer 2000). Spawning sites frequently occur near cover (Brown 1992). Migratory bull trout may begin their spawning migrations as early as April and have been known to migrate upstream as far as 250 kilometers (155 miles) to spawning grounds (Fraley and Shepard 1989). Hatching occurs in winter or early spring, and alevins may stay in the gravel for up to 3 weeks before emerging from the gravel. The total time from egg deposition to fry emergence from the gravel may exceed 220 days. Post-spawning mortality, longevity, and repeat-spawning frequency are not well known (Rieman and McIntyre 1996), but lifespans may exceed 10-13 years (McPhail and Murray 1979; Pratt 1992; Rieman and McIntyre 1993).

Bull trout are apex predators, and require a large prey base and home range. Adult and subadult migratory bull trout are primarily piscivorous, feeding on various trout and salmon species, whitefish, yellow perch (*Perca flavescens*), and sculpin. Subadult and adult migratory bull trout move throughout and between basins in search of prey. Anadromous bull trout in the Coastal-Puget Sound DPS also feed on ocean fish such as surf smelt (*Hypomesus pretiosus*) and sandlance (*Ammodytes hexapterus*). Resident and juvenile bull trout prey on terrestrial and aquatic insects, macrozooplankton, amphipods, mysids, crayfish, and small fish (Wyman 1975; Rieman and Lukens 1979 in Rieman and McIntyre 1993; Boag 1987; Goetz 1989; Donald and Alger 1993). A recent study in the Cedar River Watershed of western Washington found bull trout diets to also consist of aquatic insects, crayfish, and salamanders (Connor *et al.* 1997).

2.1.4 Habitat Requirements

Bull trout have more specific habitat requirements than other salmonids (Rieman and McIntyre 1993). Growth, survival, and long-term persistence are dependent upon the following habitat characteristics: cold water, complex instream habitat, a stable substrate with a low percentage of fine sediments, high channel stability, and stream/population connectivity. Stream temperature and substrate type, in particular, are critical factors for the sustained long-term persistence of bull trout. Spawning is often associated with the coldest, cleanest, and most complex stream reaches within basins. However, bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1995), and should not be expected to occupy all available habitats at the same time (Rieman *et al.* 1997).

While bull trout clearly prefer cold waters and nearly pristine habitat, it cannot be assumed that they do not occur in streams where habitat is degraded. Given the depressed status of some subpopulations, it is likely that individuals in degraded rivers are utilizing less than optimal habitat because that may be all that is available. In basins with high productivity, such as the Skagit River basin, bull trout may be using marginal areas when optimal habitat becomes fully occupied (Curt Kramer, WDFW, pers. comm.). Bull trout have been documented using habitats that may be atypical or characterized as likely to be unsuitable (USFWS 2000).

2.1.4.1 Temperature

For long-term persistence, bull trout populations need a stream temperature regime that ensures sufficient amounts of cold water are present at the locations and during the times needed to complete their life cycle. Temperature is most frequently recognized as the factor limiting bull trout distribution (Dunham and Chandler 2001; Rieman and McIntyre 1993). Probability of occurrence for juvenile bull trout in Washington is relatively high (75%) when maximum daily temperatures did not exceed approximately 11°-12°C (Dunham *et al.* 2001). Water temperature also seems to be an important factor in determining early survival, with cold water temperatures resulting in higher egg survival and faster growth rates for fry and juveniles (Pratt 1992). Optimum incubation temperatures range from 2° to 6°C. At 8° C to 10°C, survival ranged from 0-20 percent (McPhail and Murray 1979). Stream temperatures for tributary rearing juvenile bull trout are also quite low, ranging from 6° to 10° C (Buchanan and Gregory 1997; Goetz 1989; Pratt 1992; McPhail and Murray 1979).

Increases in stream temperatures can cause direct mortality, increased susceptibility to disease or other sublethal effects, displacement by avoidance (McCullough *et al.* 2001; Bonneau and Scarnechia 1996), or increased competition with species more tolerant of warm stream temperatures (Rieman and McIntyre 1993; Craig and Wissmar 1993 cited in USDI (1997); MBTSG 1998). Brook trout, which can hybridize with bull trout, may be more competitive than bull trout and displace them, especially in degraded drainages containing fine sediment and higher water temperatures (Clancy 1993; Leary *et al.* 1993). Recent laboratory studies suggest bull trout are at a particular competitive disadvantage in competition with brook trout at temperatures >12°C (McMahon *et al.* 2001).

Although bull trout require a narrow range of cold water temperatures to rear, migrate, and reproduce, they are known to occur in larger, warmer river systems that may cool seasonally, and which provide important migratory corridors and forage bases. For migratory corridors, bull trout typically prefer water temperatures ranging between 10°-12°C (McPhail and Murray 1979; Buchanan and Gregory 1997). When bull trout migrate through stream segments with higher water temperatures they tend to seek areas offering thermal refuge such as confluences with cold tributaries (Swanberg 1997), deep pools, or locations with surface and groundwater exchanges in alluvial hyporheic zones (Frissell 1999). Water temperatures above 15°C are believed to limit bull trout distribution, which partially explains their generally patchy distribution within a watershed (Fraley and Shepard 1989; Rieman and McIntyre 1995).

2.1.4.2 Substrate

Bull trout show a strong affinity for stream bottoms and a preference for deep pools in cold water streams (Goetz 1989; Pratt 1992). Stream bottom and substrate composition are highly important for juvenile rearing and spawning site selection (Rieman and McIntyre 1993; Graham *et al.* 1981; McPhail and Murray 1979). Fine sediments can influence incubation survival and emergence success (Weaver and White 1985; Pratt 1992) but might also limit access to substrate interstices that are important cover during rearing and over-wintering (Goetz 1994; Jakober 1995). Rearing densities of juvenile bull trout have been shown to be lower when there are higher percentages of fine sediment in the substrate (Shepard *et al.* 1984). Due to this close connection to substrate, bed load movements and channel instability can negatively influence the survival of young bull trout.

2.1.4.3 Cover and Stream Complexity

Bull trout of all age classes are closely associated with cover, especially during the day (Baxter and McPhail 1997; Fraley and Shepard 1989). Cover may be in the form of overhanging banks, deep pools, turbulence, large wood, or debris jams. Young bull trout use interstitial spaces in the substrate for cover and are closely associated with the stream bed. This association appears to be more important for bull trout than for other salmonid species (Pratt 1992; Rieman and McIntyre 1993).

Bull trout distribution and abundance is positively correlated with pools and complex forms of cover, such as large or complex woody debris and undercut banks, but may also include coarse substrates (cobble and boulder) (Rieman and McIntyre 1993; Jakober 1995; MBTSG 1998). Studies conducted with Dolly Varden showed that population density declined with the loss of woody debris after clearcutting or the removal of logging debris from streams (Bryant 1983; Dolloff 1996; Elliott 1986; Murphy *et al.* 1986).

Large pools, consisting of a wide range of water depths, velocities, substrates, and cover, are characteristic of high quality aquatic habitat and an important component of channel complexity. Reduction of wood in stream channels, either from present or past activities, generally reduces pool frequency, quality, and channel complexity (Bisson *et al.* 1987; House and Boehne 1987; Spence *et al.* 1996). Large wood in streams enhances the quality of habitat for salmonids and contributes to channel stability (Bisson *et al.* 1987). It creates pools and undercut banks, deflects streamflow, retains sediment, stabilizes the stream channel, increases hydraulic complexity, and improves feeding opportunities (Murphy 1995). By forming pools and retaining sediment, large wood also helps maintain water levels in small streams during periods of low stream flow (Lisle 1986).

2.1.4.4 Channel and Hydrologic Stability

Due to the bull trout's close association to the substrate, bed load movements and channel instability can reduce the survival of young bull trout. Maintaining bull trout habitat requires stream channel and flow stability (Rieman and McIntyre 1993). Bull trout are exceptionally sensitive to activities that directly or indirectly affect stream channel integrity. Juvenile and adult bull trout frequently inhabit areas of reduced water velocity, such as side channels, stream margins, and pools that are easily eliminated or degraded by management activities (Rieman and McIntyre 1993). Channel dewatering caused by low flows and bed aggradation has blocked access for spawning fish resulting in year class failures (Weaver 1992). Timber harvest and the associated roads may cause landslides that affect many miles of stream through aggradation of the streambed.

Patterns of stream flow and the frequency of extreme flow events that influence substrates may be important factors in population dynamics (Rieman and McIntyre 1993). With lengthy overwinter incubation and a close tie to the substrate, embryos and juveniles may be particularly vulnerable to flooding and channel scour associated with the rain-on-snow events that are common in some parts of the range (Rieman and McIntyre 1993). Surface/groundwater interaction zones, which are typically selected by bull trout for redd construction, are increasingly recognized as having high dissolved oxygen, constant cold water temperatures, and increased macro-invertebrate production.

2.1.4.5 Migration

The persistence of migratory bull trout populations requires maintaining migration corridors. Stream habitat alterations that restrict or eliminate bull trout migrations corridors include degradation of water quality (especially increasing temperatures and increased amounts of fine sediments), alteration of natural stream flow patterns, impassable barriers (such as dams and culverts), and structural modification of stream habitat (such as channelization or removal of cover). In the Coastal-Puget Sound DPS, migratory corridors may link seasonal marine and freshwater habitats as well as linking lake, river and tributary complexes that are necessary for bull trout to complete their life history requirements.

The importance of maintaining the migratory life history form of bull trout, as well as migratory runs of other salmonids that may provide a forage base for bull trout, is repeatedly emphasized in the scientific literature (Rieman and McIntyre 1993; MBTSG 1998; Dunham and Rieman 1999; Nelson *et al.* 2002). Isolation and habitat fragmentation resulting from migratory barriers have negatively affected bull trout by 1) reducing geographical distribution (Rieman and McIntyre 1993; MBTSG 1998); 2) increasing the probability of losing individual local populations (Rieman and McIntyre 1993; MBTSG 1998; Dunham and Rieman 1999; Nelson *et al.* 2002); 3) increasing the probability of hybridization with introduced brook trout (Rieman and McIntyre 1993); 4) reducing the potential for movements in response to developmental, foraging, and seasonal habitat requirements (MBTSG 1998; Rieman and McIntyre 1993); and 5) reducing reproductive capability by eliminating the larger, more fecund migratory form from many subpopulations (MBTSG 1998; Rieman and McIntyre 1993). Therefore, restoring connectivity and restoring the frequency of occurrence of the migratory form will be an important factor in the recovery of bull trout.

Unfortunately, migratory bull trout have been restricted or eliminated in parts of their range due to stream habitat alterations including seasonal or permanent obstructions, detrimental changes in water quality, increased temperatures, and the alteration of natural stream flow patterns. Dam and reservoir construction and operations have altered major portions of bull trout habitat throughout the Columbia River basin. Dams without fish passage create barriers to fluvial and adfluvial bull trout which isolates populations. The operations of dams and reservoirs alter the natural hydrograph, thereby affecting forage, water temperature, and water quality (USDI 1997).

2.1.5 Marine Phase

Anadromous bull trout forage and mature in the nearshore marine habitats on the Washington coast and in Puget Sound. These nearshore marine habitats have been significantly altered by human development (PSWQAT 2000). Construction of bulkheads and other structures have modified the nearshore areas and resulted in habitat loss that has directly affected forage fish for bull trout. Other impacts to the marine environment include alterations to water quality resulting from fish pathogens, nutrients and toxic contaminants, urbanization, and stormwater runoff from basins that feed Puget Sound. Global changes in sea level and climate may also have more widespread ramifications on these habitats, and on the Puget Sound ecosystem as a whole (Klarin *et al.* 1990; Thom 1992).

The marine and estuarine residency period for bull trout is poorly understood. The lack of data requires using literature for other species, such as Dolly Varden and cutthroat trout. Thorpe's (1994) review of salmonid estuarine use found that anadromous Dolly Varden stay close to the shoreline. He found little evidence in the literature that the estuary was used for physiological adjustment or as a refuge from predation, but did find clear evidence of a trophic advantage to estuarine residency (abundant prey).

While in the estuary, native char can grow very quickly. Subadults grow from 20 to 40 mm per month and reach a length of 250 to 350 mm before their upstream migration in late summer and early fall (Kraemer 1994). Smith and Slaney (1979) studied Dolly Varden from 1975 to 1978 on Vancouver Island. They found that first time spawners were generally 400 to 525 mm in length, that Dolly Varden subadults average 280 mm (150 mm to 470 mm) during their upstream migration after their first ocean migration, and that subadults gained 74 mm and adults 45 mm in length during their marine residency.

Kraemer (1994) speculated that the distribution of native char in marine waters may be closely tied to the distribution of bait fish and coincident with their spawning beaches. Char from Puget Sound have been found to prey on surf smelt, Pacific herring, Pacific sand lance, pink salmon smolts, chum salmon smolts, and a number of invertebrates (Kraemer 1994). The Quinault Indian Nation (*in litt.* 1995) documented smelt as a prey item for native char in the Queets River.

The Alaska Department of Fish and Game (1963) studied Dolly Varden on Afognak Island, Alaska. They found that Dolly Varden migrate to the sea in the spring and return to fresh water in the fall. Some Dolly Varden were found as far as 30 miles off shore. Kraemer (1994) has documented fish in Puget Sound as far as 25 miles from their natal stream. Armstrong (1965) conducted a massive marking study on thousands of fish in southeast Alaska to determine the migratory habits of anadromous Dolly Varden. He found marked fish in 25 different stream systems as far as 72 miles from their natal stream. Some fish became widely distributed in a short period of time (3 to 10 days). They spent an average of 116 days in marine waters. About 40 percent of the marked fish appeared to stray or migrate to other streams during the winter. He also reported that Dolly Varden migrated directly to saltwater and did not backtrack or linger in the river, the fish appeared to be absent from marine waters from December to March, downstream migration began in late March and ended in mid-July, and upstream migration continued from late May to early December.

Smith and Slaney (1979) found downstream migration of Dolly Varden to occur from mid-March to mid-June and upstream migration to occur from mid-July to the end of October. DeCicco (1992) showed that movements of anadromous Dolly Varden are much greater than previously known, are not always coastal in nature, and suggest movement of stocks over a wide geographic area (freshwaters of Alaska and the Soviet Union). Thorpe (1994) indicated that Dolly Varden were found in regions close to river mouths, within meters of the shoreline, but may also travel several hundred kilometers from their natal river's mouth. Kraemer (as cited in Nightingale and Simenstad 2001) observed that native char foraging in the estuary in less than 3 meters of water and were often seen foraging in water less than 0.5 meters deep. He also indicated that they tend to remain within tens of miles from their natal streams.

2.1.6 Coastal-Puget Sound DPS

The Service has identified 34[1] subpopulations of native char (bull trout and/or Dolly Varden) within the Coastal-Puget Sound DPS. These subpopulations were grouped into five analysis areas based on their geographic location: Coastal, Strait of Juan de Fuca, Hood Canal, Puget Sound, and Transboundary. These groupings were made in order to identify trends that may be specific to certain geographic areas. In subpopulations where it is not known if the native char that occur there are bull trout, Dolly Varden or both, they are addressed together as "native char" in this discussion. This does not imply that both exist within a subpopulation when the words "native char" are used, but merely that the subpopulation of char has not been positively identified as bull trout and/or Dolly Varden.

Genetic analysis has been conducted on 9 of the 34 native char subpopulations. Samples from five of the nine subpopulations were determined to contain only bull trout (Green River, Queets River, Upper Elwha River, Cushman Reservoir and Lower Skagit River). Two were determined to contain only Dolly Varden (Canyon Creek and Upper Sol Duc River). The Upper Quinault River subpopulation contained both bull trout and Dolly Varden. No samples had evidence of hybridization.

Within the Coastal-Puget Sound DPS, 12 of the 34 native char subpopulations are known to contain bull trout based on either genetic or morphometric measurement data. In 7 of these 12

[1] In the proposed rule to list the bull trout (FR 63 31693), the Service had delineated 35 subpopulations. Upon further review, they revised the total number to 34, when they concluded that the Puyallup River Basin had only two subpopulations as opposed to three. They made this revision in order to be consistent with the defined subpopulation criteria.

subpopulations, Dolly Varden are also believed to be present. In 3 out of the remaining 22 subpopulations, only Dolly Varden are currently known to be present. It should be noted that in most cases, identification was based on a limited number of samples, so it is possible that bull trout may also occur in the three subpopulations that, to date, have only yielded Dolly Varden. The Service believes that the current identification trend of subpopulations within the Coastal-Puget Sound population segment indicates the high likelihood of bull trout being present in the majority of remaining subpopulations.

The Service analyzed data on bull trout relative to subpopulations because fragmentation and barriers have isolated bull trout throughout their current range. A subpopulation is considered to be a reproductively isolated group of bull trout that spawns within a particular area of a river system. Subpopulations were considered at risk of extirpation from naturally occurring events if they were 1) unlikely to be reestablished by individuals from another subpopulation; 2) limited to a single spawning area; and, either 3) characterized by low individual or spawner numbers; or 4) primarily of a single life-history form. The Service rated a subpopulation as either "strong," "depressed," or "unknown," modified after Rieman *et al.* (1997). A subpopulation is considered "strong" if 5,000 individuals or 500 spawners likely occur in the subpopulation, abundance appears stable or increasing, and life-history forms were likely to persist; and "depressed" if less than 5,000 individuals or 500 spawners likely occur in the subpopulation, abundance appears to be declining, or a life-history form historically present has been lost. If there was insufficient abundance, trend, and life-history information to classify the status of a subpopulation as either "strong" or "depressed", the status was considered "unknown".

Within the Coastal-Puget Sound DPS, 4 of the 34 delineated native char subpopulations are rated as "healthy" by WDFW, and the remaining 31 are of "unknown" status. Native char subpopulations rated as "healthy" by WDFW are: 1) Queets River; 2) Upper Dungeness River; 3) Cushman Reservoir on the Skokomish River; and, 4) the Lower Skagit River. Currently, all but the Upper Dungeness River subpopulation have been determined to consist of bull trout. The Service believes that the "healthy" status designation for the Queets River, Cushman Reservoir, and Upper Dungeness River subpopulations is not appropriate. Because of information indicating recent declines in the Cushman Reservoir subpopulation, (WDFW 1998) and the lack of recent information for the Queets River subpopulation (general decline indicated by fish/day seining data between 1977 and 1991, and no trend information for 1991 to 1997), (WDFW 1998), an "unknown" rating better describes their status. The Upper Dungeness River subpopulation status is "tentatively considered healthy" by WDFW based on a single distributional and abundance survey conducted in 1996 (WDFW 1998).

The only subpopulation in the Coastal-Puget Sound DPS determined to be "strong" by the Service in the final listing rule (USDI 1999) is the Lower Skagit subpopulation, in the Puget Sound analysis area. The status of the other fourteen subpopulations in the Puget Sound analysis area are described as follows: Nisqually - depressed; Lower Puyallup - depressed; Upper Puyallup - unknown; Green - depressed; Cedar River/Chester Morse - depressed; Sammamish/Issaquah - depressed; Snohomish/Skykomish - unknown; Stillaguamish - unknown; Gorge, Diablo, and Ross Reservoirs - each unknown; Lower Nooksack, Canyon Creek, and Upper Middle Fork Nooksack - each unknown.

Within the Strait of Juan de Fuca analysis area, both the Lower Elwha and the Lower Dungeness/Gray Wolf subpopulations are considered "depressed" and the Upper Elwha, Morse Creek, and Upper Dungeness subpopulations are "unknown." The following subpopulations within the Coastal analysis area are also considered "unknown:" Chehalis/Grays Harbor, Copalis, Moclips, Lower Quinault, Upper Quinault, Raft, Queets, Goodman, and Upper Sol Duc. The status of the Hoh subpopulation is "depressed." Within the Hood Canal analysis area, the status of the South Fork/Lower North Fork Skokomish and the Lake Cushman subpopulations are "depressed" and the Upper North Fork Skokomish is "unknown." The Chilliwack River/Selesia Creek subpopulation is the single subpopulation in the Transboundary analysis area and its status is considered "unknown."

2.1.6.1 Status of the Green River/Duwamish Subpopulation

The status of the Green River/Duwamish subpopulation is unknown. There is very limited information available on the status of bull trout in the Green/Duwamish River basin. Bull trout are presumed to occur in very low numbers in this system, and no spawning locations are known. The life history forms of bull trout in this drainage are also unknown. A historical account suggests that bull trout were once common (Suckley and Cooper 1860). Bull trout may have exclusively used the Green/Duwamish River as a migration corridor into the White River and its tributaries before the White River was artificially channeled into the Puyallup (Jeff Chan, FWS, pers. comm. 2002). Creel counts on the Green River dating from 1940 indicate bull trout are extremely rare, with only four char taken by over 35,500 anglers checked between 1940 and 1973 (Cropp, WDW, *in litt.* 1993). Cropp indicated that though few in number, char are still occasionally caught in the Green River. A native char caught in May 1994 in the Duwamish River was positively identified as a bull trout both by Haas measurements (Haas and McPhail 1991) and by genetic work (Eric Warner, Muckleshoot Indian Tribe, pers. comm. 1997). Most recently, eight native char were captured in the Duwamish turning basin near RM 5.1 in August and September of 2000 (Taylor Associates 2001), and one bull trout was captured in September of 2002, and one at Kellogg Island in May of 2003 (Chan, FWS, pers. comm. 2002).

2.1.7 Changes in Status of the Coastal-Puget Sound DPS

The overall status of the Coastal-Puget Sound DPS has not improved since the listing on June 10, 1999. The status of the Coastal-Puget Sound DPS has been affected by a number of actions addressed through Opinions prepared under section 7 of the Act, and by several sections 10(a)(1)(B) permits issued for Habitat Conservation Plans (HCP). Appendix 1 summarizes the Opinions addressing bull trout that have been issued for Federal actions (excluding those issued for section 10 (a)(1)(B) permits) within the Coastal-Puget Sound DPS since November 1999. Most of these actions resulted in a degradation of the environmental baseline; all permitted the incidental take of bull trout.

A number of HCPs have been completed within the range of the spotted owl in California, Oregon and Washington. Of these, three HCPs have been amended to include bull trout. The three amendments were for the Washington State Department of Natural Resources (WDNR), Plum Creek Timber Company, and the West Fork Timber HCPs.

The WDNR's HCP amendment (USDI 1998b) to include bull trout allowed for incidental take of bull trout associated with habitat degradation/loss due to 29 miles of road construction and maintenance per year, and 158 acres of selective and thinning harvest per year. This amendment added only the Coastal-Puget Sound DPS and the lower Columbia River downstream from Greenleaf and Hamilton Creeks in the Columbia River DPS.

The Plum Creek Timber Company's HCP amendment (USDI 1998c) added the Columbia River DPS of bull trout to their HCP. The amendment allowed for the take of bull trout associated with habitat degradation/loss due to 150 acres of selective and thinning/restoration-oriented silvicultural harvest per year, 2 miles of stream restoration per year, and 20.2 miles of road construction, maintenance, and removal per year. The term of the Plum Creek HCP and permit is 50 to 100 years.

The West Fork Timber (previously Murray Pacific Corporation) amendment (USDI 2002) added the Coastal-Puget Sound bull trout DPS to their HCP. The HCP ensures that sufficient amounts of habitat types are maintained or enhanced for bull trout on West Fork Timber's land. The term of the West Fork Timber HCP and permit is 100 years.

Three recent HCPs have been completed in the Coastal-Puget Sound Analysis area that includes bull trout. The City of Seattle's Cedar River Watershed HCP includes: Chester Morse reservoir operations and activities associated with restoration planting of about 1,400 acres; restoration thinning of about 11,000 acres; ecological thinning of about 2,000 acres; instream habitat restoration projects; removal of approximately 240 miles of road over the first 20 years; maintenance of about 520 miles of road per year at the start of the HCP, diminishing as roads are removed over time to about 380 miles per year at year 20; and improvement of about 4 to 10 miles of road per year. The term of the City of Seattle HCP and permit is 50 years.

The Simpson Timber HCP encompasses 261,575 acres, with approximately 354 miles of fish bearing stream habitat in the Chehalis and Skokomish River drainages in Western Washington. Bull trout currently utilize lotic waters in the South Fork Skokomish River watershed, but they also may also be found in low numbers within the Wynoochee and Satsop River watersheds (Chehalis River basin). The Service authorized bull trout take as a result of timber harvest and experimental thinning associated with stream habitats on 2,987 acres over the 50 year permit term. In addition, the Service authorized take for bull trout associated with habitat adjacent to 250 acres of new road construction, and with habitat adjacent to potential remediation of 2,001 miles of system roads (during the first 15 years of the proposed permit term, 100 percent of all roads needing remediation would have such work completed). By year 15 of the HCP, effects to bull trout habitat resulting from road remediation should be eliminated. The term of the Simpson Timber HCP and permit is 50 years.

The Tacoma Public Utilities Green River HCP addresses effects to listed species from the management of 15,000 acres of forest in the upper Green River Watershed, including approximately 110 stream miles, and Tacoma's municipal water withdrawal from Green River at river mile 61.0. Distribution of bull trout in the upper watershed, above Howard Hanson Dam, has not been documented and only a few individuals have been found in the lower Green River and the Duwamish Waterway (King County 2000; Taylor Associates, *in litt,* 2001). The Service permitted the incidental take of bull trout resulting from water withdrawal activities affecting the middle and lower Green River, even-aged harvest of 3,285 acres, uneven-aged harvest of 2,000 acres, and the construction, maintenance, and decommissioning of 113 miles of road. The term of the Tacoma HCP and permit is 50 years.

2.1.8 Relationship of the Subpopulations to Survival and Recovery of Bull Trout in a DPS

Leary and Allendorf (1997) reported evidence of genetic divergence among bull trout subpopulations, indicating relatively little genetic exchange between them. Recolonization of habitat where isolated bull trout subpopulations have been lost is either unlikely to occur (Rieman and McIntyre 1993) or will only occur over extremely lengthy time periods. Remnant or regional populations without the connectivity to refound or support local populations have a greater likelihood of extinction (Rieman and McIntyre 1993; Rieman *et al.* 1997; MBTSG 1998).

Healy and Prince (1995) reported that, because phenotypic diversity is a consequence of the genotype interacting with the habitat, the conservation of phenotypic diversity is achieved through conservation of the subpopulation within its habitat. They further note that adaptive variation among salmonids has been observed to occur under relatively short time frames (e.g., changes in genetic composition of salmonids raised in hatcheries, and the rapid emergence of divergent phenotypes for salmonids introduced to new environments). Healy and Prince (1995) conclude that while the loss of a few subpopulations within an ecosystem might have only a small effect on overall genetic diversity, the effect on phenotypic diversity and, potentially, overall population viability, could be substantial. This concept of preserving variation in phenotypic traits that is determined by both genetic and environmental (i.e., local habitat) factors has also been identified by Hard (1995) as an important component in maintaining intraspecific adaptability (i.e., phenotypic plasticity) and ecological diversity within a genotype. Hard argues that adaptive processes are not entirely encompassed by the interpretation of molecular genetic data; in other words, phenotypic and genetic variation in adaptive traits may exist without detectable variation at the molecular genetic level, particularly for neutral genetic markers. Therefore, the effective conservation of genetic diversity necessarily involves consideration of the conservation of biological units smaller than taxonomic species (or DPSs). Reflecting this theme, the maintenance of local subpopulations has been specifically emphasized as a mechanism for the conservation of bull trout (Rieman and McIntyre 1993).

Based on this information, the Service concludes that each bull trout subpopulation is an important phenotypic, genetic, and distributional component of its respective DPS. Therefore, adverse effects that compromise the functional integrity of a bull trout subpopulation will be considered an appreciable reduction in the likelihood of survival and recovery of the entire DPS, by reducing the distribution and potential ecological and genetic diversity of the DPS.

2.1.9 Conservation Needs of the Coastal-Puget Sound DPS

The recovery of bull trout in the Coastal-Puget Sound DPS will depend on the reduction of the adverse effects that result from dams, timber harvest, agriculture practices, road building, urbanization, fisheries management, and by remedying legacy effects from past activities. General conservation needs include the following:

- Providing/maintaining stream passage and removing "man-made" impassable barriers to allow for recolonization of previously occupied habitat and for the promotion of genetic exchange.

- Screening water control structures and diversions in order to prevent entrapment and injury.

- Implementing land use (i.e. agricultural, forestry, industrial) practices that will minimize chemical and nutrient contaminated run-off and loss of riparian vegetation in order to improve water quality and quantity in streams.

- Improving approaches to urbanization and road building, such as requiring setbacks from stream banks and marine shorelines, and adequately treating stormwater run-off in order to minimize impacts to foraging and migratory habitats.

- Reducing associated incidental mortality of bull trout from commercial, recreational, and Tribal salmon and steelhead harvest.

- Restoring suitable habitat for all life history forms of bull trout in areas degraded by past human activities.

The Coastal-Puget Sound DPS is unique in that it contains the only known anadromous life history form of bull trout. Conservation needs for this recovery unit extend into the marine environment. As described above, anadromous bull trout use the marine habitats for foraging and growth. There has been a documented decline in forage fish, bottom fish, and wild salmon in Puget Sound (PSWQAT 2000). This decline has been attributed to human encroachment and development of the nearshore areas throughout Puget Sound, and has resulted in the loss of nearshore habitat[2]. It is likely that anadromous bull trout have been impacted by the decline in forage base and loss of habitat in the marine environment. Additional conservation needs pertaining to the marine environment include the following:

- Preserving and restoring healthy forage fish populations.
- Preserving and restoring nearshore habitats that support forage fish.

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[2] Nearshore habitat, 65 feet below MLW to 200 feet upland of the OHWM, generally encompasses several of the following habitats: bluffs, beaches, marshes, riparian vegetation, sandflats, mudflats, rock and gravel habitats, unvegetated subtidal areas, kelp beds, intertidal algae, and eelgrass beds (PSWQAT 2000).

- Reducing human encroachment and development along the marine shoreline and within nearshore areas.

2.2 Evaluating Proposed Actions

The standards for determining jeopardy are set forth in Section 7(a)(2) of the ESA as defined by 50 CFR Part 402 (the consultation regulations). NOAA Fisheries and the FWS must determine whether the action is likely to jeopardize the listed species. This analysis involves the initial steps of 1) defining the biological requirements and current status of the listed species, and 2) evaluating the relevance of the environmental baseline to the species' current status.

NOAA Fisheries and the FWS are required to evaluate whether the action is likely to jeopardize the listed species by determining if the species can be expected to survive with an adequate potential for recovery. In making this determination, NOAA Fisheries and the FWS must consider the estimated level of injury and mortality attributable to 1) collective effects of the proposed or continuing action, 2) the environmental baseline, and 3) any cumulative effects. This evaluation must take into account measures for survival and recovery specific to the listed species' life stages that occur beyond the action area. A finding of jeopardy is appropriate if the action, together with the baseline conditions and cumulative effects, appreciably reduces the species' likelihood of survival or recovery by reducing the numbers, distribution, or reproduction of the species. If NOAA Fisheries and the FWS find that the action is likely to jeopardize PS chinook salmon and/or Coastal-Puget Sound bull trout, NOAA Fisheries and the FWS must identify reasonable and prudent alternatives for the action.

For this specific action, NOAA Fisheries' and the FWS analysis considers the extent to which the proposed action impairs the function of habitat elements necessary for rearing, and migration of PS chinook salmon and/or Coastal-Puget Sound bull trout. The Lower Duwamish Waterway is the major migratory pathway for PS chinook salmon in the Green/Duwamish Basin and is used for foraging and rearing by Coastal-Puget Sound bull trout. The Green/Duwamish may have historically been used as a migratory corridor for bull trout when the White River converged with the Green (J. Chan pers. comm.)

2.2.1 Biological Requirements

The first step NOAA Fisheries and the FWS use when conducting the ESA section 7(a)(2) analysis is to define the species' biological requirements within the action area. NOAA Fisheries and the FWS then considers the current status of the listed species taking into account species information, *e.g.*, population size, trends, distribution, and genetic diversity. To assess the current status of the listed species, NOAA Fisheries and the FWS start with the determinations made in its decision to list these species for ESA protection within the ESU and DPS considered in this Opinion, and also consider any new data that are relevant to the determination.

Biological requirements are those necessary for the listed species within the ESU and DPS to survive and recover to a naturally reproducing population level at which time protection under the ESA would become unnecessary. This will occur when populations are large enough to safeguard the genetic diversity of the listed species within the ESU and DPS, enhance their capacity to adapt to various environmental conditions, and allow them to become self-sustaining (chinook only since bull trout are not artificially propagated) in the natural environment. The biological requirements for PS chinook salmon and Coastal-Puget Sound bull trout include adequate food (energy) sources, flow regimes, water quality, habitat structures, passage conditions (migratory access to and from potential spawning and rearing areas), and biotic interactions (Spence *et al.* 1996). The specific biological requirements for PS chinook salmon and Coastal-Puget Sound bull trout that are influenced by the action considered in this Opinion include food, water quality, habitat structure, and biotic interactions.

2.2.2 Environmental Baseline, PS Chinook and Coastal-Puget Sound Bull Trout

The environmental baseline represents the current conditions to which the effects of the proposed action would be added. The term "environmental baseline" means "the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process" (50 CFR 402.02). The action area for the proposed project is considered to be that portion of the lower Duwamish River beginning at the upstream limit of the winter salt wedge at approximately River Mile (RM) 9 extending downstream to include inner Elliott Bay.

The Duwamish River originates at the confluence of the Green and Black Rivers near Tukwila, Washington, then flows northeast for approximately 12 river miles, dividing at the southern end of Harbor Island to form the East and West Waterways prior to discharging into Elliott Bay at Seattle, Washington. A segment of the river, downstream of Turning Basin #3, is maintained by the U.S. Army Corps of Engineers as a federal navigation channel.

Lingering effects of more than a century of human development combined with numerous ongoing activities form the present environmental baseline conditions in the action area. These activities include expanding urban development, railroads, shipping, logging, agriculture, and other industries. These expansions result in the increase of industrial waste, storm water runoff from impervious surface, freshwater diversions for industrial and domestic use, and flood control (Howard Hanson Dam, RM 64, and numerous levees).

Development began to affect the lower Duwamish River in the early 1900s. Diversion of tributaries reduced the river's drainage basin by 71 percent and its average flow by more than 70 percent. At about the same time, the river was dredged to create the Duwamish Waterway, replacing nine meandering miles of river with a straight, deep, 4-mile long navigation channel (EBDRP 1994).

Of the shoreline between the mouth and RM 6.5 (about 1.3 RM above the limit of navigation at the south end of the Duwamish Waterway), 44 percent is riprapped, 34 percent covered by pier aprons and 7 percent faced with vertical sheet piling (derived from data by Tanner 1991). Furthermore, a considerable portion of the remaining intertidal and shallow subtidal portions of the Lower Duwamish Waterway is covered by barges (Muckleshoot Indian Tribe Fisheries Department [MITFD], unpub. data). The effects of eliminating natural shorelines were compounded by the filling of marshes and mudflats, the creation of steep bulkhead and riprap banks, the removal of vegetation, and the construction of buildings, piers, and impervious pavement. Altogether, these actions eliminated about 98 percent of the lower Duwamish River's emergent marshes and intertidal mudflats and 100 percent loss of tidal swamps (Blomberg *et al.* 1988). The surviving highly modified habitats generally provide poor habitat for salmon (Spence *et al.* 1996).

The Duwamish River was a major river estuary before 1853. Typically such an estuary provide habitat elements necessary for the survival of juvenile chinook salmon by providing backwater areas for osmoregulatory transition (conversion from freshwater to saltwater habitats) and rearing habitat as well as holding habitats for adult salmon waiting to ascend the river to spawning grounds. Juvenile chinook salmon normally use side channels for feeding, avoiding predators, and resting, while undergoing their physiological change to salt water. Rapid growth also occurs in estuaries due to the abundance of preferred food. The historical migration routes of anadromous salmonids into off-channel distributary channels and sloughs have largely been eliminated and historical saltwater transition zones are lacking (Kerwin 1999). Bull trout, like other anadromous salmonids, utilize the estuarine environment as holding habitats before ascending the river to spawn and for feeding and rearing.

The proposed project is located adjacent to existing port container cargo facilities at Terminal 30, Terminal 25, and in channel approach areas serving the south berth areas at Terminal 18. The downstream portion of the project is located approximately 3,000 feet before the waterway converges with Elliott Bay. The navigation channel is approximately 750 feet wide and was approved at a minus 51 MLLW elevation by the 1996 Water Resources Development Act. The current subtidal elevations vary from minus 43 to minus 49 feet deep. The entire shoreline of the East Waterway consists of built shorelines committed to water-dependent marine industrial use, including approximately 10,425 linear feet of over-water concrete piling supported container cargo pier, numerous timber pier structures, and a continuous band of structurally stabilized shoreline (Blomberg 2003).

In the Lower Duwamish Waterway, the riverbanks have been straightened, steepened, hardened, and denuded of riparian vegetation. Warner and Fritz (1995) found the greatest abundance of juvenile salmon using the few remaining shallow, sloping, soft mud beaches, compared to sites having sand, gravel, or cobble substrates. The project area has a steep, riprapped upper intertidal zone, with areas of contamination, neither of which provide proper juvenile salmon habitat. However, nearby upstream in the Duwamish Waterway is the Kellogg Island area where both remnant intertidal shallows (Terminal 107 and Kellogg Island reserve) and restored upper intertidal habitats (Herring House Park) combined with extensive riparian zones are available for salmonid use. This area presents the majority of the remaining intertidal wetlands in the Duwamish estuary (Simenstad *et al.* 1991). Current research shows that juvenile chinook salmon are using these restoration sites on their emigration from the Green/Duwamish River (Fred Goetz COE, pers. comm. 2002).

Due to the narrow, shallow restriction at the southern end of the East Waterway, it receives much less of the Duwamish River flow than the West Waterway. The East Waterway acts more like a marine hydraulic system than the West Waterway because of the depth of the channel at the mouth and the shallow restriction at the southern end. Flows in the East Waterway are on the order of 2 knots compared to 3-3.5 knots in the West Waterway. The particular hydrology of the East Waterway also causes the majority of the downstream migration of salmonids to utilize the West Waterway (Bill Taylor Taylor Associates, pers. comm. 2003).

Additionally, the chemical contamination of sediments in certain areas of the Waterway has compromised the effectiveness of the small amount of habitat remaining (COE 2002). Chemicals of concern found at elevated concentrations included the polynuclear aromatic hydrocarbons, PCBs, metals (arsenic, mercury and zinc), phthalates, phenols, and pesticides (DDT, DDE, DDD). Varanasi *et al.* (1993) found juvenile chinook salmon from the Duwamish Waterway displayed a lower immune system response compared to juvenile chinook salmon from the Nisqually River, a comparable estuary without significant industrial contaminants. Species such as salmon often spend several weeks in urban estuaries where they can be exposed to urban-related contaminants that reside in the sediments and accumulate in the prey species. There is concern that these contaminants could bioaccumulate to levels that may impact the ability of the individual salmon to grow and mature properly (NOAA Fisheries 2002).

The EPA listed marine sediments around Harbor Island in 1983 as part of a Superfund site, with the lower Duwamish Waterway listed as a Federal superfund site in 2001 with the clean up of contaminants being a high priority. To further investigate the contamination and evaluate cleanup alternatives, EPA signed an Administrative Order of Consent with four of the major property owners on the waterway with potential liability for cleanup of the site. An attachment to the order, the Statement of Work, outlines the tasks necessary to achieve these goals (EPA 2003).

In summary, the environmental baseline is substantially degraded. Ninety-eight percent of historically available intertidal marsh and mudflat habitat necessary for the estuarine life stage (smoltification) of juvenile salmonids, has been lost due to the above described human activities. The remaining 2 percent of estuarine habitat is seriously degraded by the presence of toxic and hazardous contaminants in the sediments, which is the habitat for the prey organisms of juvenile salmonids. The baseline conditions of the action area are a major factor in the current depressed status of Green River chinook salmon.

2.3 Effects of the Proposed Action

NOAA Fisheries and the FWS must consider the estimated level of injury and mortality from the effects of the proposed action. ESA regulations define "effects of the action" as "the direct and indirect effects of an action on the species or habitat together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline" (50 CFR 402.02). "Indirect effects" are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

2.3.1 Direct Effects

Direct effects are the immediate effects of the project on the species or its habitat. Direct effects result from the agency action and include the effects of interrelated and interdependent actions, if present. Future Federal actions that are not a direct, interdependent, or interrelated effect of the action under consideration (and not included in the environmental baseline or treated as indirect effects) are not evaluated (50 CFR 402.02).

The direct effects of the project derive from the nature, extent, and duration of the construction activities in the water and whether the fish are migrating or rearing at that time. Direct effects of the project also include immediate habitat modifications resulting from the project. Near-term positive effects include the removal of highly contaminated materials from the area which juvenile salmonids use. Negative effects may occur during various construction activities, including the dredging of highly contaminated sediments and the possible capping of the remaining contaminated sediments underneath. However, these negative effects are confined to a relatively small area and short time period.

2.3.1.1 Dredging

The project area encompasses approximately 19.5 acres of subtidal habitat, all of which is below minus 10 ft MLLW. Dredging will remove sediments exceeding EPA's sediment quality objectives (SQO) criteria in the Duwamish East Waterway, exposing native sediment that was not subject to historical contamination or, at a minimum, cleaning up surface sediments to the point where chemical concentrations do not exceed SQO criteria. There will be no loss of nearshore habitat from this project. Approximately 200,000 cubic yards of contaminated material and 60,000 cubic yards of clean material will be dredged between January 2003 and March 2005.

The potential mechanisms by which dredging could affect PS chinook and Coastal-Puget Sound bull trout include direct mortality, injury by entrainment, sublethal effects (stress, gill damage, and increased susceptibility to disease), and behavioral responses (disruption to feeding or migration). The potential impact will be reduced by the dredging schedule, which will be limited to the period, July 16 to March 1, when fewer numbers of chinook and bull trout are likely to be present in the action area. The impacts will also be reduced by adhering to the EPA's water quality standards and by using Best Management Practices (BMPs) during operations. Long-term ecosystem effects of dredging generally include changes in the volume and area of habitat, periodic changes to primary and secondary production (food web effects), and changes in hydrodynamics and sedimentology (Nightingale and Simenstad 2001).

Biological effects to PS chinook salmon and Coastal-Puget Sound bull trout may result from: 1) temporary reduction in water quality and increased noise disturbance associated with dredging that potentially could exclude chinook salmon and bull trout from estuarine habitat; 2) seasonal loss of benthic organisms and other prey due to disturbance of the channel substrate; and, 3) potential exposure to contaminated sediments or water.

Sediment plumes are often associated with dredging. Dredging activities disturb and suspend sediment creating discoloration of the water, reducing light penetration and visibility, and changing the chemical characteristics of the water. The size of the sediment particles and tidal currents are typically correlated with the duration of sediment suspension in the water column. Larger particles, such as sand and gravel, settle rapidly, but silt and very fine sediment may be suspended for several hours. Lasalle (1988) described a downstream plume that extended 900 feet at the surface and 1,500 feet at the bottom. Lasalle (1998) also noted an increase in sediment levels upwards of 70 percent from the effect of the pressure wave created by the dredge bucket as it descended through the water.

The affects on water quality (suspended sediments and chemical composition) from dredging can have a detrimental impact on salmonids. Suspended sediments can have an adverse effect on migratory and social behavior as well as foraging opportunities (Bisson and Bilby 1982; Sigler *et al.* 1984; Berg and Northcote 1985). Servizi (1988) observed an increase in sensitive biochemical stress indicators and an increase in gill flaring when salmonids were exposed to high levels of turbidity (gill flaring allows the fish to create sudden changes in buccal cavity pressure, which acts similar to a cough). The dredging operation will use an 8 to 12 yard clamshell dredge which causes short-term localized turbidity. NOAA Fisheries and FWS believe the sediment effects will be minimal and short term as the EPA will monitor the turbidity, dissolved oxygen and other in-water parameters and will modify the operation by conventional means (*e.g.*, rate of dredging, changing bucket type, scheduling on tidal cycles), if any of the parameters exceed Clean Water Act water quality criteria.

The chemical composition of the water with suspended sediments is also affected by dredging activities. Estuarine sediments are typically anaerobic and create an oxygen demand when suspended in the water column, and in turn would decrease dissolved oxygen (DO) levels (Hicks *et al.* 1991; Morton 1976). A review of the processes associated with DO reduction (Lunz and LaSalle 1986; Lunz *et al.* 1988) suggested that DO demand of suspended sediment is a function of the amount of material placed in the water, the oxygen demand of the sediment, and duration of suspension. The DO reductions appear to be the most severe lower in the water column and usually the condition reverses with adequate tidal flushing (LaSalle 1988). Decreases in dissolved oxygen levels have been shown to affect swimming performance levels in salmonids (Bjornn and Reiser 1991). The decrease of swimming performance due to decreases in dissolved oxygen could directly affect the chinook salmon and bull trout's ability to escape potential predation or could affect their ability to forage. Lasalle (1988) found a decrease in dissolved oxygen levels from 16-83 percent in the mid to upper water column and nearly 100 percent close to the bottom during dredging. Since bull trout are associated with the bottom, this extreme decrease in dissolved oxygen could directly affect the bull trout's ability to survive. Smith *et al.* (1976) found dissolved oxygen levels up to 2.9 milligrams per liter (mg/l) during dredging activities in Grays Harbor. Hicks (1999) observed salmon avoidance reactions when dissolved oxygen levels dropped below 5.5 mg/l. Dredging fine sediments such as those found in the lower Duwamish Waterway will create a sediment plume that may not disperse rapidly because of tidal fluctuations, especially during incoming tides. This could create poor water quality (i.e., decreased DO levels) that might preclude bull trout and chinook salmon from immigrating into the Duwamish River to gain access to foraging, rearing, and/or spawning grounds. Most of the research reported to date indicated that dredging-induced DO reductions are a short term phenomena and do not cause problems in most estuarine systems (Slotta *et al.* 1974; Smith *et al.* 1976; Markey and Putnam 1976). To comply with water quality criteria at the mixing zone boundary, DO levels will be monitored during dredging and operational changes will be implemented as necessary.

Disruption of the channel bottom and entrainment by dredging has a negative impact on benthic biota and forage fish. Filter feeding benthic organisms can suffer from clogged feeding structures, reduced feeding efficiency, and increased stress levels (Hynes 1970). Dredging may also suppress the ability of some benthic species to colonize in the dredged area, thus creating a loss of benthic diversity and perhaps less food for the chinook salmon and bull trout prey species. While dredging normally causes a short-term decrease in abundance and diversity of the littoral and subtidal benthic community, the benthic community in the project area is already seriously low in diversity and number of biota due to the level of contamination and the physical quality of the substrate. Therefore, the typical reduction in benthic prey from this type of dredging is not expected within the project area. NOAA Fisheries and FWS believe the removal of contaminated sediments will provide an improved habitat for benthic organisms so that benthic abundancy and diversity will exceed present levels. In addition, benthic communities at the proposed site are expected to recover within one year after dredging activities are completed.

In summary, the EPA will reduce the likelihood of chinook and bull trout exposure to dredging by working under timing restrictions that avoid the period, March 1 through July 15, when chinook and bull trout would be expected to be present in greater numbers, as well as requiring compliance with other appropriate conservation measures described in the BE and addendums. The EPA will also monitor the chemical constituents, turbidity, dissolved oxygen and other in-water parameters, and will modify the dredging practices by conventional means (*e.g.*, rate of dredging, changing bucket type, scheduling on tidal cycles), if any of the parameters exceed Clean Water Act water quality criteria.

2.3.1.2 Water Quality

The potential for short-term loss of chemicals to the waters of Elliott Bay during project dredging was analyzed by Dredge Elutriate Testing (DRET). DRET was performed to assist in predicting water column contaminant concentrations that would result from sediment resuspension in the immediate vicinity of dredging operations. Based on the DRET results, the concentrations of contaminants in the water column resulting from dredge operations are expected to be less than water quality criteria or approximately equal to ambient concentrations at the point of compliance. To date, EPA has not consulted with the Services on the development of water quality criteria. The adequacy of EPA's marine water quality criteria for salmonids has not been fully evaluated. Consequently, we cannot conclude that these standards will provide adequate protection for salmonids. Meeting these standards, however, will reduce the potential adverse impact by limiting the concentration of hazardous chemicals to which PS chinook and Coastal-Puget Sound bull trout will be exposed.

Very little information is known about the toxicity of contaminants to bull trout. Preliminary work with freshwater toxicity levels indicates that they may be sensitive to contaminants. Hansen *et al.* (2000) found effects to bull trout from cadmium as low as 0.089 micrograms per liter (μg/L), which is much lower than EPA's chronic water quality criterion of 0.9 μg/L. Collier *et al.* (2000) suggest that current sediment quality criteria of PCBs, tributyltin, and polycyclic aromatic hydrocarbons for juvenile salmonids may be inadequate to prevent damaging their disease resistance, causing DNA damage, or reducing their prey base. Ongoing research by Lipton *et al.* (2000) has shown that measured LC50s for bull trout from cadmium and zinc were less than the national water quality criteria. Cook *et al.* (2000) demonstrated that bull trout were three times more sensitive to certain contaminants than lake trout using egg dose-dependent mortality data to 2,3,7,8-tetrachlorodibenzo-p-dioxin and PCBs. Miller (1993) found maternal transfer of PCBs in chinook salmon and lake trout (*Salvelinus namaycush*). Ankley *et al.* (1991) found an inverse relationship between PCB concentrations in eggs and hatching success in chinook salmon. Although literature is limited as far as impacts to bull trout, impacts to chinook salmon have been well documented (Arkoosh *et al.* 1998; McCain *et al.* 1990; Stein *et al.* 1995). Most of the chinook salmon and bull trout toxicity work has concluded there are adverse effects to bull trout and chinook salmon at levels lower than the existing water quality standards and that bull trout and chinook salmon that are exposed during dredging operations will be impacted by increases in contaminant levels in the water column.

2.3.1.3 Capping

After dredging, should surface sediments show that chemical results exceed Cleanup Screening Levels (CSL), representative sample areas will be dredged an additional one to two feet with a thin clean layer clean sediment cap (minimum 6-inches) to be applied. Cap material will be clean, free-draining sand graded per limits specified in the Removal Action Design Report (Anchor Environmental, 2003). The proposed clean cap material (medium to fine sand), if found necessary to apply, would replace the existing contaminated sediments and would provide improved substrate for benthic species in the project area over the long-term. Some fish may be exposed to uncapped, contaminated sediments before any necessary capping is completed.

Recent juvenile salmon injury studies in urban estuaries such as Elliott Bay and Commencement Bay have demonstrated the susceptibility of juvenile salmon to the following contaminants; PAHs, PCBs, hexachlorobutadiene, hexachlorbenzene, DDTs, heptachlor, chlorinated hydrocarbons, and several pesticides. Recent laboratory investigations have demonstrated that such contaminant exposure poses the risks of impairing growth and immunocompetence levels of exposed juvenile salmon, and increasing mortality following pathogen exposure. These findings magnify the importance of isolating and capping such contaminants for the future sustainability of salmonids and the prey base they depend on (Nightingale and Simenstad, 2001).

While short-term adverse effects associated with the capping activities are possible, these effects are expected to be temporary and would be minimized by project conservation measures and best management practices. The long-term benefits will be that the use of this material will provide clean surface area (habitat) for aquatic invertebrates.

2.3.1.4 Fish Monitoring

To complete the dredging in a timely manner, the Port has proposed work outside of currently accepted construction windows (August 31st–February 14th). In order for the Port to work beyond the accepted work window, fish monitoring is included in the proposed action to determine when juvenile salmonids are present. Additional minimization measures may be implemented during dredging depending on the result of the monitoring. The incidental take that is associated with monitoring is covered under the Port of Seattle's and Taylor and Associates section 10(a)1(A) permit (NOAA #1314, FWS #TE034300-0) and will not be discussed further in this Opinion. If work is necessary beyond the March 1 closure, the Port will contact the Services to discuss what additional control measures, based on the monitoring results, will be implemented to minimize impacts to listed species.

2.3.1.5 Beneficial Effects

Chemical concentrations in surface sediment within this area exceeded the SQS and CSL at the majority of sampling stations. The proposed action will remove approximately 200,000 cubic yards of contaminated sediment from 19.5 acres of the Duwamish River estuary. As a result, overall contamination of the Duwamish River estuary will be reduced. Dredging will also improve the substrate for aquatic organisms that are prey for juvenile salmonids and other species in the Duwamish River estuary. The overall effect of these activities will be to reduce contaminant exposure and improve the prey availability, and habitat access for juvenile salmonids and other components of the Duwamish estuary aquatic community.

2.4 Indirect Effects

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably to occur (50 CFR 402.02). Indirect effects may occur outside the area directly affected by the action. No long-term adverse changes to habitat are expected to occur as a result of the proposed action.

Aside from beneficial effects, there are no other indirect effects at the project site since this action will not change the use of the habitat beyond removing the sediment contaminants. Human activities and/or land use in the project area would not be altered in the long-term. Any future water-dependent uses occurring after the completion of this project would be subject to the required Federal permits and associated ESA consultations.

2.5 Cumulative Effects

Cumulative effects are defined as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 CFR 402.02). The project involves actions within a portion of the Duwamish Waterway which has been previously altered by dredging, filling and other anthropogenic activities. However, future Federal actions that will impact the action area, such as navigational dredging and other activities permitted under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act, will be reviewed under separate Section 7 consultations, and cannot be considered cumulative effects.

Other effects in the action area are those from other Federally funded or permitted restoration actions taking place as a part of Elliott Bay/Duwamish Restoration Program pursuant to a 1991 Consent Decree (EBDRP 1994). The Green Duwamish Ecosystem Restoration Program has identified several potential landscape and watershed scale restoration sites to increase connectivity between important salmon habitat transition regions (COE 2000).

The Lower Duwamish Waterway is a major urban industrial waterway which supports marine container and barge shipping, fishing, rail and highway transportation, cement production, shipbuilding and repair, marine construction, aircraft manufacturing, sand and gravel operations, and recreational boating, to name a few on-going non-federal activities. The face of the waterway is continually changing as new waterfront facilities and uses occur. The increased operation of the waterway's facilities may increase the number of truck and rail trips on existing roads and railroads. These are within the local or private actions that are considered to create potential cumulative effects. In this case, these uses are not expected to have any additional effect on the species of concern or their habitat.

2.6 Conclusion

NOAA Fisheries and the FWS evaluated the collective effects of the proposed action, the environmental baseline, and any direct, indirect and cumulative effects, while taking into account measures for survival and recovery specific to the listed species' life stage. We find that the project may result in short-term adverse effects on Green/Duwamish River populations of PS chinook salmon and Coastal-Puget Sound bull trout due to in-water work activities. Of the 14 indicators of the functional condition of salmon habitat (NMFS 1996), 11 would be maintained, three (chemical contaminants, substrate, and benthic community) would be improved in the long- term, and two (sediment/turbidity and benthic community) would be temporarily degraded, and then returned to baseline conditions in the Lower Duwamish Waterway. Because of the potential for water quality effects, NOAA Fisheries and the FWS agree with the EPA's conclusion that the proposed action could temporarily degrade the baseline condition for water quality at the point of dredging. Measures to avoid work in the most sensitive juvenile salmonid migration period and construction BMPs, will minimize adverse short-term effects to PS chinook salmon and bull trout.

Over the long-term, removal of highly contaminated sediments is a beneficial aspect of the project that will restore sediment and water quality. The baseline condition for benthic prey would also be temporarily degraded due to the short-term loss in productivity that would occur as a result of the project's temporary disturbance of subtidal habitat would likely return to function within one to two years. NOAA Fisheries and the FWS agree with the EPA's conclusions that the remedial action will address risks to the environment and public health, reduce the levels of chemical constituents in sediment, and thereby help improve and restore PS chinook salmon and bull trout habitat in the Lower Duwamish Waterway.

Based on the foregoing, it is NOAA Fisheries' Biological Opinion that the proposed action is not likely to jeopardize the continued existence of PS chinook salmon. Also, based on the foregoing, it is FWS's Biological Opinion that the proposed action is not likely to jeopardize the continued existence of Coastal-Puget Sound bull trout. In arriving at a non-jeopardy conclusion for this action, the minimization measures were important to consider in addition to the ultimate goal of clean sediment substrates which would support increased benthic diversity and productivity. NOAA Fisheries and the FWS find the likely potential negative effects associated with the actual construction activities are minimized through adherence to the project design objectives and conservation measures.

2.7 Reinitiation of Consultation

This concludes formal consultation on the action outlined in the request. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

2.8 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct of listed species without a specific permit or exemption (50 CFR 17.3 and 222.102).

Harass in the definition of "take" in the Act means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying to such an extent as to significantly **disrupt normal behavior patterns** which include, but are not limited to breeding, feeding, or shelter (50 CFR § 17.3).

Harm in the definition of "take" in the Act means an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly **impairing essential behavior patterns**, including breeding, feeding, or shelter (50 CFR § 17.3). "Harm" is further defined by NOAA Fisheries to include significant habitat modification or degradation that results in death or injury to a listed species by "significantly impairing essential behavioral patterns such as breeding, spawning, rearing, migrating, feeding, and sheltering" (NOAA Fisheries 50 CFR 222.102).

"Incidental take" is take of listed animal species that results from, but is not the purpose of, the Federal agency or the applicant carrying out an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action, is not considered prohibited taking provided that such takings is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by the EPA so that they become binding conditions of any grant or permit issued to the Port and/or contractor, as appropriate, for the exemption in section 7(o)(2) to apply. The EPA has a continuing duty to regulate the activity covered by this incidental take statement. If the EPA (1) fails to assume and implement the terms and conditions or (2) fails to require the Port and/or the contractor to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the EPA must report the progress of the action and its impact on the species to the Services as specified in the incidental take statement [50 CFR §402.14(I)(3)].

An incidental take statement specifies the amount of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize the effects and sets forth terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures.

2.8.1 Amount or Extent of Take Anticipated

The Services anticipate that take of PS chinook and Coastal-Puget Sound bull trout from the Green/Duwamish River subpopulations is likely to result from the proposed action.

According to the EPA, the following conservation measures will be required of the applicant, and will reduce the effect of the action on PS chinook and Coastal-Puget Sound bull trout. The Services's analysis of incidental take and jeopardy is based on the implementation of these measures:

a) EPA will require work to be conducted between July 15 through March 1 when PS chinook salmon and bull trout are less likely to be present.

b) EPA will require compliance of water quality standards by conducting water quality measurements during clean up activities for turbidity, total suspended solids and contaminants of concern at the dredge site. Appropriate monitoring would include turbidity, total suspended solids, and chemicals of concern for the first week at two tidal cycles and at two depths, and additional sampling if standards are exceeded. Samples will be taken at the edge of the mixing zone (as specified in the section CWA 401 certification) and at the halfway point within the mixing zone. Water quality sampling will include up- or down -stream reference samples (depending on the tide) to allow for turbidity due to dredging, transport or disposal operations to be separated from background turbidity. If turbidity standards under the CWA are not met at the mixing zone, the dredging/dewatering operations will cease until minimization measures are incorporated so that turbidity standards can be met.

c) EPA will supply the contractor with more detailed information regarding the dredge operation so that the dredging will be carried out in a manner that minimizes spillage of excess sediments from the bucket and minimizes the potential entrainment of fish. This includes, but is not limited to:

i) Using effective materials such as hay bales or filter fabric on the barge to avoid contaminated sediment and water from being deposited back into the river.

ii) Avoiding the practice of washing contaminated material off the barge and back into the water. This can be accomplished by the use of hay bale and/or filter fabric.

iii) Using filter fabric or some other device to minimize spillage of material into the water during the unloading of the barge to the upland facility.

iv) Using effective materials such as hay bales or eco-blocks and filter fabric to minimize contaminated sediments and water from being deposited back into the water during transportation between the barge and the upland facility.

d) EPA will provide the contractor specific directions regarding the most current, accurate GPS dredge positioning to control the horizontal and vertical extent of the dredge. A horizontal and vertical control plan will be prepared, submitted to the contractor, and adhered to by the dredge contractor to ensure dredging does not occur outside the limits of the dredge prism.

e) EPA will ensure that an emergency clean up plan is in place in the event the barge, truck, or railcar has an incident where contaminated material is spilled. This plan will be on-board the vehicle at all times.

f) EPA will use clean sand with minimal fine sediments during the capping operation.

g) EPA will analyze the capping material if it is from another dredge location than described in the Removal Action Design Report. Sediment contamination analysis will be performed on that sediment prior to its use, and must meet PSSDA standards.

h) EPA will monitor the chemical constituents, turbidity, dissolved oxygen and other in-water parameters, and will modify the dredging practices by conventional means (*e.g.*, rate of dredging, changing bucket type, scheduling on tidal cycles), if any of the parameters exceed Clean Water Act water quality criteria.

Incidental take of PS chinook and Coastal-Puget Sound bull trout is expected to occur during this dredging project. The incidental take of individual PS chinook and Coastal-Puget Sound bull trout will be difficult to detect or quantify for the following reasons: (1) low likelihood of finding dead or injured sub-adults or adults; (2) delayed mortality; (3) rapid rate of fish decomposition; and, (4) high probability of scavenging by predators. Using post-project habitat conditions as a surrogate indicator of take, the Services anticipates that the following forms of take will occur as a result of the activities associated with the project:

Incidental take due to sedimentation from dredging and sediment capping.

-Take of bull trout in the form of ***harassment*** will occur through the disruption of normal migrating and foraging behaviors associated with direct impacts resulting from elevated sediment levels, chemical levels, and/or reduced DO. Elevated sediment levels are expected to result from the in-water dredging and capping activities that are scheduled to occur during July 15 through March 1.

-Life history forms anticipated to be harassed are anadromous sub-adult and adult bull trout. The duration of take is anticipated to be any time that dredging and sediment capping operation are being conducted between July 15 through March 1 2004 and 2005.

Incidental take due to exposure to contaminated water.

-Incidental take of chinook salmon and bull trout in the form of **harm** is anticipated from the exposure to contaminated water and contaminated suspended sediments. The extent of take is expected to be all PS chinook salmon and Coastal-Puget Sound bull trout associated with the wetted area of the river, from the project site, to an area 1,500 feet downstream during dredging activities. Dredging activities are expected to last July 15 through March 1, for 8 hours per day, 6 days a week.

-Life history forms anticipated to be harmed are juvenile and sub-adult chinook salmon and anadromous sub-adult and adult bull trout throughout the 19.5 acre dredging prism. The duration of take is anticipated to be any time that dredging operation are being conducted, which is expected during the daylight hours of July 15 through March 1, 2004 and 2005.

2.8.2 Effect of the Take

In the accompanying Biological Opinion, FWS and NOAA Fisheries determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.8.3 Reasonable and Prudent Measures

The following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize the take of PS chinook salmon and Coastal-Puget Sound bull trout.

1. The EPA will minimize take during construction by avoiding or minimizing adverse effects of dredging activities on PS chinook salmon and Coastal-Puget Sound bull trout by monitoring for chinook salmon and bull trout presence during dredging operations in the month of February, when juvenile salmonids may be present.

2. Monitor the progress of the action, including implementation of the conservation measures described above, and the impact of the action on the species.

2.8.4 Terms and Conditions

In order to be exempt from the prohibitions of Section 9 of the ESA, the parties must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms are non-discretionary. The EPA should include these terms and conditions as remedial requirements under Superfund orders to the Port of Seattle.

1. The following term and condition is required for the implementation of RPM 1:

1) Weekly beach seine monitoring shall begin the first week of February at the Turning Basin in the Duwamish River at RM 5 to provide an early indication of the arrival of juvenile salmon in the lower river. A minimum of three beach seines shall be made during each sampling event. If the catch exceed 100 juvenile chinook salmon/seine, the EPA shall contact the Services to discuss potential additional monitoring requirements (*e.g.* sampling the East Waterway site).

Beach seine monitoring will take place twice weekly beginning February 15th until the end of dredging activities on March 1st. Sampling will be conducted at the head end of the East Waterway and at Slip 27 adjacent to the dredging activity. The same monitoring will also be conducted between July 15th and the first week of September. Monitoring will be spread evenly throughout the week (for example: Monday and Thursday, Tuesday and Friday). A minimum of three beach seines per monitoring day will be required. If monitoring exceeds three chinook salmon or bull trout per beach seine as an average catch (per day), EPA will be required to continue beach seining for two successive days at each site. If the additional two days of sampling exceed three chinook salmon or bull trout per seine (per day), the Services will be notified on the first day where monitoring exceeds the above thresholds so that additional impact minimization measures can be implemented. Minimization measures may include, but are not limited to: working during outgoing tides, employing a silt curtain or log boom to maintain a turbid free nearshore migration corridor, as deemed necessary by the Services. These measures will be specified and implemented into the dredging operation to minimize potential impacts to juvenile fish. The Services will have access to the sampling sites on all occasions.

2. The following term and condition is required for the implementation of RPM 2:

1. A report documenting the implementation of and compliance with the conservation measures and terms and conditions indicated above, and the level of incidental take that

has occurred, shall be submitted to NOAA Fisheries' Washington Habitat Branch and to the Western Washington Fish and Wildlife Service prior to April 1, 2005.

In addition, the FWS and NOAA Fisheries are to be notified within three (3) working days upon locating a dead, injured, or sick endangered or threatened species specimen. Initial notification must be made to the nearest U.S. Fish and Wildlife Service Law Enforcement Office and/or NOAA Fisheries office, as appropriate. Notification must include the date, time, precise location of the injured animal or carcass, and any other pertinent information. Care should be taken in handling sick or injured specimens to preserve biological materials in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. Contact FWS Law Enforcement office at (425) 883-8122 or the Western Washington Fish and Wildlife Office at (360) 753-9440 and/or contact NOAA Fisheries Law Enforcement at (360)753-4409 or the Washington Habitat Conservation Branch at (360) 753-9440.

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Appendix 1
Biological Opinions Completed for the Coastal-Puget Sound Bull Trout DPS and the Lower Columbia River Recovery Unit of the Columbia River DPS

YEAR Initiated	PROJECT NAME	PROJECT TYPE	AGENCY	LOG	SUB-POPULATION	ANALYSIS AREA (DPS)
1998-99	Plum Creek Timber Company Land Exchange	HCP	USFWS	357	Yakima Little Naches Green Rivers	Columbia River Coastal-Puget Sound
1998-00	Upper Tieton Watershed	Fisheries Studies	USFS	336	Snoqualmie River	Coastal-Puget Sound
1998-00	Gifford Pinchot National Forest	Programmatic Bull Trout	USFWS	371	Lewis River	Columbia River
1998-01	Mount Saint Helens National Monument	Rush Creek Dispersed Campsite	USFS	372	Lewis River Rush Creek	Columbia River
1998-01	Gifford Pinchot National Forest	Programmatic Bull Trout	USFS	1243	Lewis River	Columbia River
1999	Wiggs Timber Sale	Forest Management	BIA	172	Quinault River	Coastal-Puget Sound
1999	Mount Saint Helens National Monument	Programmatic Bull Trout	USFS	289	Lewis River	Columbia River Coastal-Puget Sound
1999	Four 5th Field Watershed	Forest Management	USFS	289	Lewis River	Columbia River
1999	I-90 Sunset Interchange Modifications and South Sammamish Plateau Access Road	Transportation	FHWA	642	Issaquah Creek Sammamish River	Coastal-Puget Sound
1999	Fishing Facility at Colonial Creek Campground on Diablo Reservoir	Recreation Pier	NPS	732	Skagit River, Diablo Reservoir	Coastal-Puget Sound
1999	I-90	Forest Management	USFS	742	Snoqualmie River	Coastal-Puget Sound

1999	Plum Creek Timber Company	Land Exchange	USFS, Region 6	742	Lewis River	Columbia River Coastal-Puget Sound
1999	White River Amphitheater	Commercial Development	BIA COE	829	White River Puyallup River	Coastal-Puget Sound
1999	Cedar Creek, Fish First Restoration Project	Restoration Project	USFWS	893	Lewis River	Columbia River
1999	Twin Butte Sheep & Goat and Mt. Adams Cattle Allotment	Grazing	USFS	897	White Salmon River Morrison Creek	Columbia River
1999	Gifford Pinchot National Forest	Programmatic Fish & Wildlife	USFS	944	Lewis River	Columbia River Coastal-Puget Sound
1999	Buckshot Timber Sale	Forest Management	USFS	1241	Queets Moclips Quinault Rivers	Coastal-Puget Sound
1999-00	Habitat Restoration Activities	Restoration Programmatic	USFWS	5380539	Several	Coastal-Puget Sound
1999-00	Snohomish River Bridge Scour	Transportation	FHWA	374	Snohomish River Skykomish River	Coastal-Puget Sound
1999-00	Olympic Region Road Repair	Transportation Programmatic	FHWA	111	Several	Coastal-Puget Sound
1999-01	Hopper Timber Sale	Forest Management	BIA	1184	Quinault River	Coastal-Puget Sound
2000	Ongoing and Proposed Forest Service Activities	Transportation	USFS	0016 0242	Lewis River	Columbia River
2000	Washington Conservation Reserve Enhancement Program	Restoration	USDA	64	Statewide	Columbia River Coastal-Puget Sound

2000	North Boundary Management Plan	Forest Management	BIA	149	Queets, Lake Quinault	Coastal-Puget Sound
2000	Whitney Hill Bridge	Transportation	FHWA	229	Green River	Coastal-Puget Sound
2000	Seattle Cedar River HCP	Water Supply & Hydroelectric	USFWS	243	Cedar River	Coastal-Puget Sound
2000	Riverside Bridge Replacement	Transportation	FHWA	248	Lower Skagit River	Coastal-Puget Sound
2000	Kendall Creek Riparian and Wetland Restoration	Restoration	USFWS	466	Nooksack River	Coastal-Puget Sound
2000	Ten Mile Creek Riparian Restoration	Restoration	USFWS	467	Nooksack River	Coastal-Puget Sound
2000	Grays Harbor Dredging	Corps	COE	577	Chehalis River Grays Harbor	Coastal-Puget Sound
2000	Elwha River Restoration	Restoration	NPS	606	Elwha River	Coastal-Puget Sound
2000R	I - 90 - Sunset Interchange and S. Sammamish Access Road	Transportation	FHWA	642	Issaquah Creek Sammamish River	Coastal-Puget Sound
2000	Anthracite Creek Bridge Scour Protection	Transportation	FHWA	676	Snohomish River	Coastal-Puget Sound
2000	Asarco Smelter Superfund Site Shoreline Armoring	Bank Armoring	EPA	735	Lower Puyallup	Coastal-Puget Sound
2000	Rock Creek Culvert Replacement	Transportation	COE	1069	Green River	Coastal-Puget Sound
2000	Olympic National Park Upper Hoh River Road Protection Reinitiation	Transportation	NPS	1155	Hoh River	Coastal-Puget Sound
2000	SR 20 Debris Structure	Transportation	FHWA	1230	Lower Skagit River	Coastal-Puget Sound

2000	Stossel Creek - Harris Creek Culvert Replacement	Transportation	COE	1292	Snohomish and Skykomish Rivers	Coastal-Puget Sound
2000	Howard Hanson Additional Water Storage	Corps	COE	1381	Green River	Coastal-Puget Sound
2000 2001R	West Grayback Logging Unit	Yakima 1999 Forest Management	BIA	14580398	Summit Creek Klickitat River	Columbia River
2000	Crane Creek Timber Sale	Forest Management	BIA	1459	Raft River Lake Quinault	Coastal-Puget Sound
2000	Cowlitz Subbasin Bull Trout for Cowlitz Valley Ranger District and Kirk Timber Sale	Transportation Timber Sale	USFS	14871860	Cowlitz River	Columbia River
2000	Greenwater River Channel Relocation	Restoration	USDA	1542	Lower Puyallup River	Coastal-Puget Sound
2000	Baxter Timber Sale	Forest Management	BIA	1547	Quinault River Grays Harbor	Coastal-Puget Sound
2000	Riverside Bridge Reinitiation	Transportation	FHWA	1606	Skagit River	Coastal-Puget Sound
2000	Puyallup Nation Electron Dam Fish Ladder	Restoration	COE	1705	Puyallup River	Coastal-Puget Sound
2000	Bronze Billy Timber Sale	Forest Management	USFS	1764	Cowlitz River	Columbia River
2000	Morrison Creek and Wicky Creek Bridge Replacement	Transportation	USFS	1854	White Salmon River	Columbia River
2000	Morrison Creek Horse Camp	Recreation	USFS	1856	White Salmon River	Columbia River
2000	Mt. Adams Horse Camp	Recreation	USFS	1856	Several	Columbia River

2000	Cowlitz River Bull Trout Programmatic	Transportation	USFS	18581487	Cowlitz River	Columbia River
2000	Baker Lake Road Fish Passage Improvement	Transportation	FHWA	2056	Skagit River	Coastal-Puget Sound
2000	Simpson Timber HCP	Forest Management	USFWS	2098	Skokomish River (several)	Coastal-Puget Sound
2000	S. Fork Nooksack Engineered Log Jam	Transportation	BIA	4861109	Nooksack River	Coastal-Puget Sound
2000	Ongoing and Proposed Forest Service Activities	Transportation	USFS		White Salmon River	Columbia River
2000-01	Lummi Island-Gooseberry Pt. Ferry Terminal	Emergency Ferry Maintenance	FHWA	19170170	Lower Nooksack River	Coastal-Puget Sound
2000-02	Olympic National Park Hoh Road Shoreline Protection	Transportation	NPS	1155	Hoh River	Coastal-Puget Sound
2001	Maersk Sealand Pier Extension	Transportation	COE	0065	Puyallup River	Coastal-Puget Sound
2001	Merwin, Yale, Swift No. 1 & 2 Hydroelectric Dams	Hydroelectric	FERC	70	Lewis River	Columbia River
2001	City of Tacoma HCP	Restoration	USFWS	101	Green River	Coastal-Puget Sound
2001	Everett Bridges Seismic Retrofit	Transportation	FHWA	161	Snohomish and Skykomish Rivers	Coastal-Puget Sound
2001	Tornow Bridge Repair Scour	Transportation	FHWA	167	Chehalis River Grays Harbor	Coastal-Puget Sound
2001	Lummi Island Ferry Dock Reinitiation	Transportation	FHWA	170	Lower Nooksack River	Coastal-Puget Sound

2001	Tacoma Public Utilities, Permit for Work in the White River	Pipeline	COE	252	White River	Coastal-Puget Sound
2001	North Fork Nooksack River Bridge Culvert Replacement	Transportation	FHWA	308	Lower Nooksack River	Coastal-Puget Sound
2001	SR-9 Stillaguamish River to Lake Creek	Transportation	FHWA	352	Stillaguamish River Lower Skagit	Coastal-Puget Sound
2001	West Grayback Logging Unit	Yakima 1999 Timber Sale Reinitiation	BIA	398	Summit Creek Klickitat River	Columbia River
2001	SR-2 Snohomish River Bridge Demolition	Transportation	FHWA	416	Snohomish Skykomish Rivers	Coastal-Puget Sound
2001	Trout Creek Road Repair	Transportation	USFS	440	Chehalis River Grays Harbor	Coastal-Puget Sound
2001	Lancaster Timber Sale	Forest Management	BIA	574	Lower Quinault Queets Rivers	Coastal-Puget Sound
2001	Canyon Creek Bridge	Transportation	BIA	575	Lower Quinault River	Coastal-Puget Sound
2001	Wastewater and Water Treatment Plant	Miscellaneous	BIA	697	Moclips River	Coastal-Puget Sound
2001	Asarco Smelter Superfund Site Shoreline Armoring	Reinitiation	EPA	787	Puyallup River	Coastal-Puget Sound
2001	Saxon Bank Stabilization	Bank Armoring	COE	842	Nooksack River	Coastal-Puget Sound
2001	La Conner Marina Dredging	Maintenance	COE	942	Skagit River Estuary	Coastal-Puget Sound
2001	Habitat Restoration	Restoration	USFWS	1074	Multiple	Multiple

2001	Upper Rush Creek Stream Restoration	Restoration	USFS	1246	Lewis River	Columbia River
2001	Upper Dungeness RoadRepair	Transportation	USFS	1458	Dungeness Gray Wolf Rivers	Coastal-Puget Sound
2001	Upper Rush Creek Stream Restoration	Restoration	USDA	1675	Lewis River	Columbia River
2001	Jesse James II; South 9400; Q744 Parcels	Forest Management	BIA	16772377 2378	Quinault River	Coastal-Puget Sound
2001	Fish Passage Barrier Removal Programmatic	Restoration	COE	1752	Statewide	Coastal-Puget Sound
2001	Forest Road 2180 - Decommissioning	Restoration	USFS	1914	Chehalis Grays Rivers	Coastal-Puget Sound
2001	Tacoma Yacht Club Dock "A"	Reconstruction	COE	2068	Puyallup River	Coastal-Puget Sound
2001	Canyon River Emergency Relief for Federal Roads	Transportation	USFS	2222	Chehalis River Grays Harbor	Coastal-Puget Sound
2001	Easy Timber Sale	Forest Management	BIA	2251	Quinault River	Coastal-Puget Sound
2001	Skeeters Timber Sale	Forest Management	BIA	2395	Quinault River	Coastal-Puget Sound
2002	SR-101 Nolan Creek Replacement	Transportation	FHWA	678	Hoh River	Coastal-Puget Sound
2002	Riverside Bridge Reinitiation	Transportation	FHWA	762	Skagit River	Coastal-Puget Sound
2002	Condit Hydroelectric	Hydroelectric	FERC	839	White Salmon River	Columbia River
2002	Rock Creek Culvert Replacement Reinitiation	Transportation	COE	884	Green River	Coastal-Puget Sound
2002	State Route 522 Paradise Lake Road to Cathcart Road	Transportation	FHWA	1161	Snohomish River	Coastal-Puget Sound

2002	Hylebos Waterway, Segment 5 Remediation	Superfund	COE	1203	Puyallup River	Coastal-Puget Sound
2002	SR 104, Hood Canal Bridge Retrofit	Transportation	FHWA	1484	Skokomish, Elwha, Dungeness, Puyallup, Snohomish, Stillaguamish,, and Lower Skagit Rivers	Coastal-Puget Sound
2002	Falls Creek Channel	Restoration	USFS	1584	Lake Quinault	Coastal-Puget Sound
2002	Quinault Indian Reservation 10-year Forest Management Plan	Forest Management	BIA	1602	Quinault River, Queets, River	Coastal-Puget Sound
2002	Haller/Nugents Bridge Demolition	Transportation	FHWA	1615	Nooksack River, Stillaguamish River	Coastal-Puget Sound
2002	Grandy Creek Bridge	Transportation	NPS	1765	Lower Quinault River	Coastal-Puget Sound
2002	Hylebos Waterway Area 5106, Commencement Bay Superfund Site	Restoration	EPA	1851	Puyallup River	Coastal-Puget Sound
2002	Kendall & Bonners Creek Riparian Planting and LWD Placement (KC 5-6; BC4)	Restoration	USFWS	1866 1867	Nooksack River	Coastal-Puget Sound
2002	Hoh River Revetment	Shoreline Armoring	USFS	1980	Hoh River	Coastal-Puget Sound
2002	SF5, S.F. Nooksack River Salmon Carcass Distribution	Restoration	USFWS	2118	Nooksack River	Coastal-Puget Sound

2003	State Route 167 Sumner Interchange	Transportation	COE	476	Lower Puyallup River	Coastal-Puget Sound
2003	Upper Hoh Road Engineered Log Jams	Transportation	FHWA	1128	Hoh River	Coastal-Puget Sound
2003	Graves Creek Road Repair	Transportation	NP	1336	Quinault River	Coastal-Puget Sound
2003	Upper Hoh Road Engineered Log Jams Reinitiation	Transportation	FHWA	1966	Hoh River	Coastal-Puget Sound

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat Consultation

NOAA FISHERIES No. 2003/01335

East Waterway
Phase 1 Non-Time Critical Removal Action, Harbor Island Superfund Site
Duwamish Waterway, Seattle, Washington

Agency: US Environmental Protection Agency

Consultation Conducted By: National Marine Fisheries Service, Northwest Region

Approved: Michael R Crouse Date: May 4, 2004

D. Robert Lohn
Regional Administrator

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MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

1.0 Background

On October 23, 2003 the National Marine Fisheries Service (National Oceanic and Atmospheric Administration [NOAA Fisheries]) received an Essential Fish Habitat (EFH) Assessment and request for Magnuson-Stevens Fishery Conservation and Management Act (MSA) consultation from the United States Environmental Protection Agency (EPA).

The Port of Seattle (Port) is proposing in-water dredging activities in the East Waterway of the Duwamish (Figure 1) with the concurrent objectives of sediment cleanup and navigational improvements. The Port has agreed to remove sediments contaminated with polychlorinated biphenyls (PCBs), pesticides, bis (2-ethylhexyl) phthalate, polyaromatic hydrocarbons (PAHs), phenols, chlorobenzenes, and metals including mercury, zinc, and tributyltin from the lower Duwamish River estuary near Seattle, Washington [Water Resource Inventory Area (WRIA 9)]. Approximately 200,000 cubic yards of contaminated material and 60,000 cubic yards of clean material would be excavated from 19.5 acres of subtidal habitat with final dredge elevation at -51 feet Mean Lower Low Water (MLLW). All dredging would occur in subtidal areas with elevation depths greater than minus 10 MLLW. Disposal of the contaminated sediments from this project will be at an approved upland facility while the clean material will be disposed of at the Puget Sound Dredge Disposal Analysis (PSDDA) site in Elliot Bay.

The Duwamish River originates at the confluence of the Green and Black Rivers near Tukwila, Washington, then flows northeast for approximately 21 river kilometers, dividing at the southern end of Harbor Island to form the East and West Waterways prior to discharging into Elliot Bay at Seattle, Washington. A segment of the river, downstream of Turning Basin #3 is maintained by the US Army Corps of Engineers as a federal navigation channel.

The proposed project is located adjacent to existing port container cargo facilities at Terminal 30, Terminal 25, and in channel approach areas serving the south berth areas at Terminal 18. The downstream portion of the project is located approximately 3,000 feet before the waterway converges with Elliot Bay. The navigation channel is approximately 750 feet wide and was approved at a minus 51 MLLW elevation by the 1996 Water Resources Development Act. The current subtidal elevations vary from minus 43 to minus 49 feet deep. The entire shoreline of the East Waterway consists of built shorelines committed to water-dependent marine industrial use, including approximately 10,425 linear feet of over-water concrete piling supported container cargo pier, numerous timber pier structures, and a continuous band of structurally stabilized shoreline (Blomberg 2003).

In the long-term, removal and isolation of the contaminated sediments will benefit the species that utilize the lower Duwamish River. However, short-term adverse effects on fish associated with the project activities are possible, including harm resulting from increased turbidity, water quality effects, contaminant exposure, and potential fish entrainment during dredging activities. These effects are expected to be temporary and would be minimized by project conservation measures and best management practices.

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance Essential Fish Habitat (EFH) for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2));
- NOAA Fisheries must provide conservation recommendations for any Federal or State action that would adversely affect EFH (§305(b)(4)(A));
- Federal agencies must provide a detailed response in writing to NOAA Fisheries within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NOAA Fisheries EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.110). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (*e.g.,* contamination or physical disruption), indirect (*e.g.,* loss of prey or reduction in species fecundity), site-specific or habitat-wide effects, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810).

Any reasonable attempt to encourage the conservation of EFH must take into account actions that occur outside EFH, such as upstream and upslope activities, which may have an adverse effect on EFH. Therefore, EFH consultation with NOAA Fisheries is required by Federal agencies regarding any activity that may adversely affect EFH, regardless of its location.

The objective of this EFH consultation is to determine whether the proposed action may adversely affect designated EFH, and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH resulting from the proposed action.

2.0 Identification of EFH

Pursuant to the MSA the Pacific Fisheries Management Council (PFMC) has designated EFH for federally-managed fisheries within the waters of Washington, Oregon, and California. The designated EFH for groundfish and coastal pelagic species encompasses all waters from the mean high water line, and upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon and California, seaward to the boundary of the U.S. exclusive economic zone (370.4 km)(PFMC 1998a, 1998b). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC), and longstanding, naturally-impassable barriers (*i.e.*, natural waterfalls in existence for several hundred years) (PFMC 1999). In estuarine and marine areas, designated salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone (370.4 km) offshore of Washington, Oregon, and California north of Point Conception to the Canadian border.

Detailed descriptions and identifications of EFH are contained in the fishery management plans for groundfish (Casillas *et al.* 1998, PFMC 1998a), coastal pelagic species (PFMC 1998b), and Pacific salmon (PFMC 1999). Assessment of the effects to these species' EFH from the proposed action is based on these descriptions and information provided by EPA.

3.0 Proposed Actions

The proposed action and action area are detailed above in Section 1 of this document. The action area includes habitats that have been designated as EFH for various life-history stages of 17 species of groundfish, four coastal pelagic species, and three species of Pacific salmon (attachment).

4.0 Effects of Proposed Action

The proposed action may result in detrimental short- and long-term effects to a variety of habitat parameters. These adverse effects include temporary reduction in water quality and increased noise disturbance, short term degradation of benthic foraging habitat, and potential exposure to contaminants during dredging activities.

4.1 Dredging

The project area encompasses approximately 19.5 acres of subtidal habitat, below -10 ft MLLW. Biological effects to aquatic species may include: 1) temporary reduction in water quality and increased noise disturbance associated with dredging that potentially could exclude aquatic species from estuarine habitat; 2) seasonal loss of benthic organisms and other prey due to disturbance of the channel substrate; and, 3) potential exposure to contaminated sediments or water.

Sediment plumes are often associated with dredging. Dredging activities disturb and suspend sediment creating discoloration of the water, reducing light penetration and visibility, and changing the chemical characteristics of the water. The size of the sediment particles and tidal currents are typically correlated with the duration of sediment suspension in the water column. Larger particles, such as sand and gravel, settle rapidly, but silt and very fine sediment may be suspended for several hours. Lasalle (1988) described a downstream plume that extended 900 feet at the surface and 1500 feet at the bottom. Lasalle (1998) also noted an increase in sediment levels upwards of 70 percent from the effect of the pressure wave created by the bucket as it descends through the water.

The effects on water quality (suspended sediments and chemical composition) from dredging can have a detrimental impact on aquatic species. Suspended sediments can have an adverse effect on migratory and social behavior as well as foraging opportunities (Bisson and Bilby 1982; Sigler et al. 1984; Berg and Northcote 1985). Servizi (1988) observed an increase in sensitive biochemical stress indicators and an increase in gill flaring when salmonids were exposed to high levels of turbidity (gill flaring allows the fish to create sudden changes in buccal cavity pressure, which acts similar to a cough). Chemical composition of the water when sediments are suspended is also affected by dredging activities. Estuarine sediments are typically anaerobic and create an oxygen demand when suspended in the water column, and in turn would decrease dissolved oxygen levels (Hicks et al. 1991; Morton 1976). Decreases in dissolved oxygen levels have been shown to affect swimming performance levels in salmonids (Bjornn and Reiser 1991). The decrease of swimming performance due to decreases in dissolved oxygen could directly affect the ability to escape potential predation or could affect their ability to forage on motile fish. Lasalle (1988) found a decrease in dissolved oxygen levels from 16-83 percent in the mid to upper water column and nearly 100 percent close to the bottom. Smith et al. (1976) found dissolved oxygen levels up to 2.9 milligrams per liter (mg/l) during dredging activities in Grays Harbor. Dredging fine sediments such as those found in the lower Duwamish Waterway will create a sediment plume that may not disperse rapidly because of tidal fluctuations, especially during incoming tides. The EPA will monitor turbidity, dissolved oxygen and other in-water parameters and will modify the operation by conventional means (*e.g.* rate of dredging, changing bucket type, scheduling on tidal cycles), if any of the parameters exceed the Clean Water Act water quality criteria.

Disruption of the channel bottom and entrainment by dredging has a negative impact on benthic and prey fish resources. Dredging physically disturbs the channel bottom, eliminating or displacing established benthic communities, thus reducing prey availability to aquatic species or their forage species. Filter feeding benthic organisms can suffer from clogged feeding structures, reduced feeding efficiency, and increased stress levels (Hynes 1970). Dredging may also suppress the ability of some benthic species to colonize in the dredged area, thus creating a loss of benthic diversity and food source. However, benthic communities at the proposed site are expected to recover within one year after dredging activities are completed resulting in a temporal loss versus long term loss.

4.2 Water Quality

The potential for short-term loss of chemicals to the waters of Elliott Bay during project dredging was analyzed by Dredge Elutriate Testing (DRET). DRET was performed to assist in predicting water column contaminant concentrations that would result from sediment resuspension in the immediate vicinity of dredging operations. Based on the DRET results, the concentrations of contaminants in the water column resulting from dredge operations are expected to be less than water quality criteria or approximately equal to ambient concentrations at the point of compliance. To date, EPA has not consulted with NOAA Fisheries on the marine development of water quality criteria. The adequacy of EPA's marine water quality criteria for aquatic species has not been fully evaluated. Consequently, we cannot conclude that these standards will provide adequate protection for aquatic species. The meeting of these standards, however, will reduce the potential adverse impact by limiting the concentration of hazardous chemicals to which aquatic species will be exposed.

4.3 Capping

After dredging, should surface sediments show that chemical results exceed Cleanup Screening Levels (CSL), representative sample areas will be dredged an additional one to two feet with a thin clean layer clean sediment cap (minimum 6-inches) to be applied. Cap material will be clean, free-draining sand graded per limits specified in the Removal Action Design Report (Anchor Environmental, 2003). The proposed clean cap material (medium to fine sand), if it is necessary, would replace the existing contaminated sediments and would provide improved substrate for benthic species in the project area over the long-term.

Recent juvenile salmon injury studies in urban estuaries such as Elliot Bay and Commencement Bay have demonstrated the susceptibility of juvenile salmon to the following contaminants; PAHs, PCBs, hexachlorobutadiene (HCBD), hexachlorbenzene (HCB), DDTs, heptachlor, chlorinated hydrocarbons, and several pesticides. Recent laboratory investigations have demonstrated that such contaminant exposure poses the risk of impairing growth and immunocompetence levels of these juvenile salmon, and increasing mortality following pathogen exposure. Especially at risk, are the bottom fish that feed the most directly from benthic organisms exposed to these chemicals. These finding magnify the importance of isolating and capping such contaminants for the future sustainability of aquatic species and the prey base they depend on (Nightingale and Simenstad, 2001).

While short-term adverse effects associated with the capping activities are possible, these effects are expected to be temporary and would be minimized by project conservation measures and best management practices. The long-term benefits will be that the use of this material will provide clean surface area (habitat) for aquatic invertebrates.

4.4 Beneficial Effects

Chemical concentrations in surface sediment within this area exceeded the SQS and CSL at the majority of sampling stations. The proposed action will remove approximately 200,000 cubic yards of contaminated sediment from 19.5 acres of the Duwamish River estuary. As a result, overall contamination of the Duwamish River estuary will be reduced. Dredging will also improve the substrate for aquatic organisms that are prey for many aquatic species in the Duwamish River estuary. The overall effect of these activities will be to reduce contaminant exposure and improve the prey availability, and habitat access for components of the Duwamish estuary aquatic community.

4.5 Summary of Adverse Effects

As described above the proposed action may adversely affect designated EFH for the species in Table 1. These adverse effects are:

1) temporary reduction in water quality and increased noise disturbance associated with dredging that potentially could exclude aquatic species from estuarine habitat;
2) loss of benthic organisms and other prey due to disturbance of the channel substrate; and
3) potential exposure to contaminated sediments or water.

5.0 Conclusion

NOAA Fisheries believes that the proposed action may adversely impact the EFH for the groundfish, coastal pelagic, and Pacific salmon species listed in Table 1.

6.0 EFH Conservation Recommendations

According to the EPA, the following conservation measures will be required of the applicant, and will reduce the effect of the action on EFH species.

a) EPA will require compliance of water quality standards by conducting water quality measurements during clean up activities for turbidity, total suspended solids and contaminants of concern at the dredge site. Appropriate monitoring would include turbidity, total suspended solids, and chemicals of concern for the first week at two tidal cycles and at two depths, and additional sampling if standards are exceeded. Samples will be taken at the edge of the mixing zone (as specified in the section Clean Water Act (CWA) 401 certification) and at the halfway point within the mixing zone. Water quality sampling will include up- or down -stream reference samples (depending on the tide) to allow for turbidity due to dredging, transport or disposal operations to be separated from background turbidity. If turbidity standards under the CWA are not met at the mixing zone, the dredging/dewatering operations will cease until minimization measures are incorporated so that turbidity standards can be met.

b) EPA will supply the contractor with more detailed information regarding the dredge operation so that the dredging will be carried out in a manner that minimizes spillage of excess sediments from the bucket and minimizes the potential entrainment of fish. This includes, but is not limited to:

i) Using effective materials such as hay bales or filter fabric on the barge to avoid contaminated sediment and water from being deposited back into the river.

ii) Avoiding the practice of washing contaminated material off the barge and back into the water. This can be accomplished by the use of hay bale and/or filter fabric.

iii) Using filter fabric or some other device to minimize spillage of material into the water during the unloading of the barge to the upland facility.

iv) Using effective materials such as hay bales or eco-blocks and filter fabric to minimize contaminated sediments and water from being deposited back into the water during transportation between the barge and the upland facility.

c) EPA will provide the contractor specific directions regarding the most current, accurate Global Positioning System (GPS) dredge positioning to control the horizontal and vertical extent of the dredge. A horizontal and vertical control plan will be prepared, submitted to the contractor, and adhered to by the dredge contractor to ensure dredging does not occur outside the limits of the dredge prism.

d) EPA will ensure that an emergency clean up plan is in place in the event the barge, truck, or railcar has an incident where contaminated material is spilled. This plan will be on-board the vehicle at all times.

e) EPA will use clean sand with minimal fine sediments during the capping operation.

f) EPA will analyze the capping material if it is from another dredge location than described in the Removal Action Design Report. Sediment contamination analysis will be performed on that sediment prior to its use, and must meet PSSDA standards.

g) EPA will monitor the chemical constituents, turbidity, dissolved oxygen and other in-water parameters, and will modify the dredging practices by conventional means (*e.g.,* rate of dredging, changing bucket type, scheduling on tidal cycles), if any of the parameters exceed CWA water quality criteria.

Because the conservation measures that the EPA included as part of the proposed action are adequate to avoid, minimize, or otherwise offset potential adverse impacts to the EFH of the species in Table 1, conservation recommendations pursuant to MSA (§305(b)(4)(A)) are not necessary. Since NMFS is not providing conservation recommendations at this time, no 30-day response from the EPA is required (MSA §305(b)(4)(B)).

7.0 Supplemental Consultation

EPA must reinitiate EFH consultation with NOAA Fisheries if the proposed action is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR 600.920(l)).

8.0 References

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Table 1. Species of fishes with designated EFH in the estuarine composite of Puget Sound.

Groundfish Species	Sablefish *Anoplopoma fimbria*	**Coastal Pelagic Species**
Spiny Dogfish *Squalus acanthias*	Bocaccio *S. paucispinis*	anchovy *Engraulis mordax*
California Skate *R. inornata*	Brown Rockfish *S. auriculatus*	Pacific sardine *Sardinops sagax*
Ratfish *Hydrolagus colliei*	Copper Rockfish *S. caurinus*	Pacific mackerel *Scomber japonicus*
Lingcod *Ophiodon elongatus*	Quillback Rockfish *S. maliger*	market squid *Loligo opalescens*
Cabezon *Scorpaenichthys marmoratus*	English Sole *Parophrys vetulus*	**Pacific Salmon Species**
Kelp Greenling *Hexagrammos decagrammus*	Pacific Sanddab *Citharichthys sordidus*	chinook salmon *Oncorhychus tshawytscha*
Pacific Cod *Gadus macrocephalus*	Rex Sole *Glyptocephalus zachirus*	coho salmon *O. kisutch*
Pacific Whiting (Hake) *Merluccius productus*	Starry Flounder *Platichthys stellatus*	Puget Sound pink salmon *O. gorbuscha*